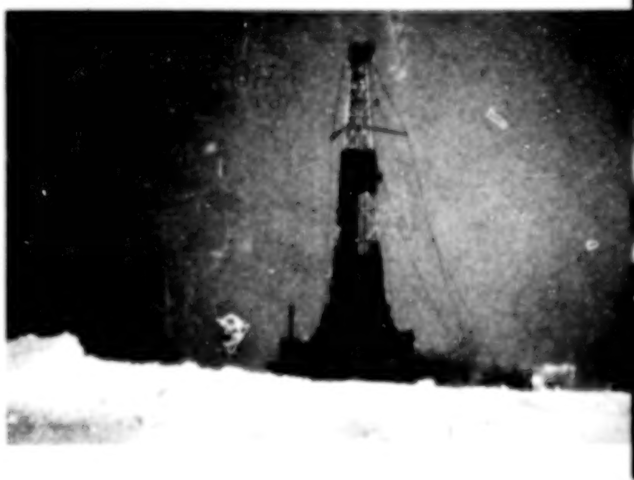
Bureau of Land Management

in cooperation with the
U.S. Department of the Interior
Minerals Management Service

December 1997

Northeast National Petroleum Reserve-Alaska

Draft Integrated Activity Plan/ Environmental Impact Statement



99-027543

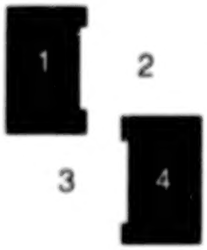
BEST COPY AVAILABLE

COMPLETED

BLANK PAGE

It is the mission of the Bureau of Land Management to sustain the health, diversity and productivity of the public lands for the use and enjoyment of present and future generations.

BLM/AK/PL-98/003+3130+930



Cover photos:
1. Anne Morkill, Bureau of Land Management
Photo of Dora Itta of Barrow
2. © D. Roby & K. Brink/VIREO
Photo of Spectacled Eider
3. © BP Exploration (Alaska) Inc.
Photo of Exploratory Drill Rig
4. U.S. Fish & Wildlife Service
Photo of Caribou

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
ALASKA STATE OFFICE
222 W. 7th Avenue, #13
ANCHORAGE, ALASKA 99513-7599

November 17, 1997

Dear Reader,

Welcome to the Draft Integrated Activity Plan/Environmental Impact Statement for the Northeast National Petroleum Reserve-Alaska. We at BLM are glad to provide this document to you.

This draft presents a range of alternative future management options for 4.6 million acres in northeastern NPR-A. These lands are the property of the American people, and we need to know your thoughts on how you want your land managed.

We welcome your comments. We have tried very hard to get the information presented here right, but we are on the lookout for ways to improve it. If you see errors in our portrayal of the resources or flaws in our analysis, please offer corrections.

Let us know what you like and don't like among the various proposals included in the alternatives. Describe why given options are better than others.

We have not developed a Preferred Alternative. We will create the Proposed Action in the Final IAP/EIS from the five alternatives in this document. If you believe that the best management for the area would take elements from several of the alternatives presented here, let us know those elements that you believe are worthy of inclusion in the final plan.

You may comment through the NPR-A homepage (http://aurora.ak.blm.gov/npra/) or by writing to:

NPR-A Planning Team
Bureau of Land Management
Alaska State Office (930)
222 W. 7th Avenue
Anchorage, Alaska 99513-7599

The public comment period for this Draft IAP/EIS ends February 10, 1998. Public hearings will be held in Barrow, Nuiqsut, Atqasuk, Fairbanks, and Anchorage, Alaska, and in Washington, D.C. The dates for the public hearings will be announced in our newsletter, *npr-a update*, on the NPR-A homepage, in newspaper advertisements, and in a notice in the *Federal Register*.

Finally, I would like to thank all the people who have helped us develop this plan. While the ultimate responsibility for what is between these covers is BLM's, we have benefitted from the participation of many individuals and agencies. North Slope residents have shared with us their wealth of knowledge about the planning area and its resources. The public, scientific and technical experts from academia and the private sector, various interest groups, and industry have presented their views and provided us insights on the area. I am especially grateful to the Minerals Management Service, the U.S. Fish and Wildlife Service, the State of Alaska, and the North Slope Borough for their advice throughout this process.

If you have questions about the process or this document, please contact Gene Terland (907-271-3344; gterland@ak.blm.gov) or Jim Ducker (907-271-3369; jducker@ak.blm.gov).

Sincerely,

Tom Allen

State Director

Northeast
National Petroleum Reserve-Alaska

Draft
Integrated Activity Plan/
Environmental Impact Statement

Prepared by

U.S. Department of the Interior
Bureau of Land Management

in cooperation with the

U.S. Department of the Interior
Minerals Management Service

December 1997

N

Northeast National Petroleum Reserve-Alaska
Draft Integrated Activity Plan/Environmental Impact Statement

---

Lead Agency:	U.S. Department of the Interior, Bureau of Land Management
Proposed Action:	Northeast National Petroleum Reserve-Alaska (NPR-A) Draft Integrated Activity Plan/Environmental Impact Statement (IAP/EIS) for lands within the North Slope Borough, Alaska
Abstract:	The Northeast NPR-A IAP/EIS will determine the appropriate multiple-use management of 4.6 million acres of public lands in the NPR-A. This draft puts forward five alternatives; there is no Preferred Alternative. The alternatives propose designating some lands in recognition of their outstanding surface values. These designations include establishing one new Special Area (a designation established by the National Petroleum Reserve Production Act for areas of high resource value that would obtain especially high protection), enlarging an existing Special Area, recommending that much of the Colville River and lands immediately adjacent to it be designated a National Wild and Scenic River by Congress, and creation of a Bird Conservation Area. The alternatives also include a range of options for making lands available for oil and gas leasing, from making no lands available to making all lands available. The alternatives also propose a range of stipulations that would be attached to BLM authorizations to mitigate impacts to resources.
For Further Information:	Contact Gene Terland (907-271-3344; gterland@ak.blm.gov) or Jim Ducker (907-271-3369; ducker@ak.blm.gov). They can be reached by mail at the Bureau of Land Management (930), Alaska State Office, 222 W. 7th Avenue, Anchorage, Alaska 99513-7599.

✓

SUMMARY

The Bureau of Land Management (BLM) Northeast National Petroleum Reserve-Alaska (NPR-A) Integrated Activity Plan/Environmental Impact Statement (IAP/EIS) is designed to determine the appropriate multiple-use management of 4.6 million acres of the NPR-A. To do this, BLM is addressing two major questions: (1) What protections and enhanced management will be implemented for surface resources such as wildlife; wildlife habitat; fisheries; and paleontological, subsistence, and recreation resources within the planning area? (2) Will the BLM conduct oil and gas lease sales in the planning area and, if so, what lands will be made available for leasing?

In addressing these questions BLM, in partnership with the public and many Federal, State, and North Slope Borough government agencies who have assisted in this planning effort, has focused on the relationships of the current and potential uses of the planning area and the impact of those uses on the natural and human resources of the area. In this analysis, specific uses, resources, and portions of the planning area have stood out as especially significant.

Subsistence activities, particularly hunting and fishing, in the planning area are exceedingly important to local residents, including the Inupiat, the Native people of Alaska's North Slope. Subsistence hunting and fishing are central to the Inupiat's ages-old cultural system. Moreover, subsistence activities provide critical sustenance for these people who live off Alaska's road network at an extreme distance from the Nation's food-distribution system.

The potential use of the area for oil development is the primary focus of much of the analysis in the IAP/EIS. North Slope oil production, centered at the massive Prudhoe Bay field, is key to the Nation's domestic oil supply. The North Slope contributes about 20 percent of America's current domestic production. The oil industry has discovered and developed other fields both to the east and west of Prudhoe. However, production is in decline from these older fields, and there are indications that the planning area contains fields that can help to stem the decline.

Two portions of the planning area and their associated surface resources stand out as especially important. The northern third of the area near Teshekpuk Lake has extraordinary wildlife. It is the home of the Teshekpuk Lake Caribou Herd. The herd calves in the lands around the lake and provides much of the meat harvested by nearby North Slope villagers. This part of the planning area also is the summer breeding and nesting ground for waterbirds that annually migrate north from throughout the Americas. Spectacled and Steller's eiders, both recently added to the list of threatened and endangered species, are among the birds using the area. In addition, large numbers of waterfowl, including in some years over 20 percent of all the world's black brant, spend the critical flightless molting period along the shores of the scores of lakes north and east of Teshekpuk. The area also provides fish for local residents.

The Colville River valley is the other particularly important portion of the planning area. It provides important habitat for raptors, including the arctic peregrine falcon that, until 1994, was listed as an endangered species; neotropical migratory birds; moose; and fish. In addition, it contains world-class paleontological deposits and is an important all-season access corridor.

The IAP/EIS offers five alternative future management plans for public comment. No Preferred Alternative has been identified. The BLM wants the public's thoughts on all the options offered in this draft document before it selects a specific plan.

Some elements are common to several alternatives. Stipulations would be imposed on authorized activities under all of the alternatives. These stipulations are designed to protect surface resources. The scope of the stipulations increases with each alternative from Alternative A to Alternative E. Alternative A has the least number of stipulations, primarily because it would not authorize oil and gas leasing, so no stipulations to address that activity needed to be included. Alternatives B through E make progressively more lands available for oil and gas leasing. Consequently, stipulations are added to the alternatives to mitigate impacts from the increasingly larger area and numbers and kinds of resources potentially impacted by development. For example, relatively few stipulations specifically protect caribou from oil and gas exploration and development under Alternatives A through C, because the most important caribou habitat is not made available under those alternatives. Specific stipulations, such as restrictions on where and how oil facilities can be sited, are provided for caribou protection under Alternatives D and E, which make important caribou habitat available for leasing.

Several alternatives recommend creation of specially designated areas. The Secretary of the Interior is authorized to identify specific lands in the NPR-A as "Special Areas." Areas around Teshekpuk Lake and the Colville River were designated as Special Areas in 1977. Under some of the alternatives, BLM would recommend that the Secretary designate lands along the Ikpikpuk River important for their paleontological values as a Special Area and that the Secretary add the Pik Dunes, an unusual feature in the planning area with importance for caribou, to the Teskekpuk Lake Special Area. Under various alternatives, BLM would recommend that Congress designate the Colville River as a wild, scenic, or recreation river under the Wild and Scenic Rivers Act (WSRA). Wild designation generally would exclude certain activities and structures, such as motorized use and aboveground pipelines, which would detract from the river corridor's remote and primitive characteristics. Scenic and recreation status offer progressively less restrictive management to protect scenic, recreation, and other values associated with the river. In several alternatives, BLM is proposing that it work with nearby land owners, including the State and the Arctic Slope Regional Corporation, to create a Bird Conservation Area under the Partners in Flight Program. This designation would highlight consideration of this habitat for land managers. Should a new Special Area, a Wild and Scenic River, or a Bird Conservation Area result from the plan, BLM would draft specific plans or studies for these areas. Finally, under some alternatives, BLM is proposing to undertake a plan to guide future studies of caribou and waterbird populations in the Teshekpuk Lake area.

The alternatives are:

Alternative A (No Action Alternative): Alternative A reflects current BLM management of the planning area. The BLM would continue to authorize such activities as winter overland supply moves to North Slope villages, other scientific studies, and Special Recreation Permits for commercial guides. (All alternatives would allow such activities to continue.) Alternative A has two options, one allowing seismic (as is currently the case) and one prohibiting seismic. (Seismic is allowed under all other alternatives.) No oil and gas leases would occur and no new designations, such as Special Areas, Wild and Scenic Rivers, or Bird Conservation Areas, would be proposed.

Alternative B: Alternative B would make nearly half of the planning area available for oil and gas leasing, while emphasizing protection of specific surface resources. Lands identified as important for paleontological resources, recreational use, and habitat for caribou, waterbirds, and fish would not be made available for oil and gas leasing. Lands from which the village of Nuiqsut's Alaska Native Claims Settlement Act corporation are entitled to select would not be leased for oil and gas until the corporation's entitlement has been satisfied. An area along the Ikpikpuk River would be recommended as a new Special Area and the alternative would recommend that the Pik Dunes be added to the Teshekpuk Lake Special Area. A corridor along the Colville River would be recommended as a "wild" river under the WSRA, and BLM would work with adjacent landowners to establish a Bird Conservation Area along the Colville and some of its tributaries.

Alternative C: Alternative C would make nearly three-quarters of the planning area available for oil and gas leasing. The Teshekpuk Lake Caribou Herd's calving area, as well as the important waterbird and fish habitat areas around Teshekpuk Lake would remain unavailable for oil and gas leasing. An area along the Ikpikpuk River would be recommended as a new Special Area and the alternative would recommend that the Pik Dunes be added to the Teshekpuk Lake Special Area. A corridor along the Colville River would be recommended as a "scenic" river under the WSRA, and BLM would work with adjacent landowners to establish a Bird Conservation Area along the Colville and some of its tributaries.

Alternative D: Alternative D would make nearly 90 percent of the planning area available for oil and gas leasing. The important goose- molting area north and east of the Teshekpuk Lake, which also encompasses part of the caribou-calving area, would remain unavailable for oil and gas leasing. An area along the Ikpikpuk River would be recommended as a new Special Area and the alternative would recommend that the Pik Dunes be added to the Teshekpuk

Lake Special Area. A corridor along the Colville River would be recommended as a "recreation" river under the WSRA, and BLM would work with adjacent landowners to establish a Bird Conservation Area along the Colville and some of its tributaries.

Alternative E: Alternative E would make all BLM-administered lands in the planning area available for oil and gas leasing. An area along the Ikpikpuk River would be recommended as a new Special Area and the alternative would recommend that the Pik Dunes be added to the Teshekpuk Lake Special Area. The BLM would work with adjacent landowners to establish a Bird Conservation Area along the Colville and some of its tributaries.

BLANK PAGE

CONTENTS

Abstract, **iii**
Summary, **v**
Table of Contents, **ix**
List of Figures and Tables, **xiv**
List of Acronyms and Symbols, **xix**

I. INTRODUCTION, I-1
A. Purpose and Needs, **I-1**
B. Background, **I-2**
  1. Administrative History of the National Petroleum Reserve-Alaska, **I-2**
  2. Special Areas, **I-2**
  3. Planning Area, **I-2**
  4. Relationship of the IAP/EIS to Past BLM Plans in the Planning Area, **I-8**
  5. Process, **I-8**
C. Issues, **I-9**

II. ALTERNATIVES, II-1
A. Introduction, **II-1**
B. Land Use Emphasis Areas (LUEA's), **II-1**
  1. Teshekpuk Lake Watershed, **II-1**
  2. Goose Molting Habitat, **II-2**
  3. Spectacled Eider Nesting Concentrations, **II-2**
  4. Teshekpuk Lake Caribou Habitat, **II-2**
  5. Fish Habitat, **II-2**
  6. Colville River Raptor, Passerine, and Moose Area, **II-2**
  7. Umiat Recreation Site, **II-2**
  8. Scenic Areas, **II-2**
  9. Pik Dunes, **II-3**
  10. Ikpikpuk Paleontological Sites, **II-3**
  11. Kuukpik Corporation Entitlement, **II-3**
  12. Potential Colville Wild and Scenic River, **II-3**
C. Alternatives, **II-19**
  1. Preferred Alternative or Proposed Action, **II-19**
  2. Alternative A, **II-19**
  3. Alternative B, **II-19**
  4. Alternative C, **II-19**
  5. Alternative D, **II-19**
  6. Alternative E, **II-20**
  7. Stipulations, **II-27**
D. Comparison of Alternatives, **II-35**
E. Need for Further NEPA Analysis, **II-35**
F. Interrelationships, **II-35**
  1. Introduction , **II-35**
  2. Endangered Species Act and National Historic Preservation Act Consulation and Coastal Zone Management, **II-38**
  3. Wild and Scenic Rivers Act Compliance, **II-38**
  4. Alaska National Interest Lands Claims Act Section 810 Compliance, **II-38**
  5. Future Interrelationships, **II-38**
  6. Subsistence Advisory Panel, **II-39**
G. Alternatives and Issues Considered but Eliminated from Detailed Analysis, **II-39**

III. DESCRIPTION OF THE AFFECTED ENVIRONMENT, III-A-1
A. Physical Characteristics, **III-A-1**
  1. Terrestrial Environment, **III-A-1**
    a. Geology, **III-A-1**
      (1) Mineral Potential, **III-A-1**
      (2) Petroleum Geology, **III-A-1**
      (3) Oil and Gas Resource Assessment, **III-A-11**
    b. Physiography, **III-A-31**
      (1) The Planning Area, **III-A-31**
      (2) The Arctic Coastal Plain Province, **III-A-31**
      (3) The Arctic Foothills Province, **III-A-32**
      (4) The General Area, **III-A-32**
    c. Soils, **III-A-32**
      (1) Major Land Resource Areas, **III-A-32**
      (2) The Soil Classification System, **III-A-34**
    d. Sand and Gravel, **III-A-35**
      (1) Materials, **III-A-35**
      (2) Regulatory Environment, **III-A-35**
      (3) Engineering Techniques, **III-A-35**
    e. Paleontological Resources, **III-A-35**
    f. Oil and Gas Exploration — Environmental Status, **III-A-36**
      (1) Background, **III-A-36**
      (2) Framework for Exploration-Site Jurisdiction, **III-A-41**
      (3) Continuing Work of Researchers, **III-A-41**
    g. Hazardous Materials, **III-A-41**
      (1) General Characterization of Hazardous and Solid Wastes in the Northeast NPR-A Planning Area Environment, **III-A-41**
      (2) Distribution and Number of sites Within the Planning Area, **III-A-42**
  2. Aquatic Environment, **III-A-42**
    a. Water Resources, **III-A-42**
      (1) Climatic Factors, **III-A-42**
      (2) Groundwater, **III-A-42**
      (3) Surface Water, **III-A-45**

    - b. Water Quality, **III-A-47**
      - (1) Potability, **III-A-48**
      - (2) Turbidity, **III-A-48**
      - (3) Alkalinity and pH, **III-A-48**
      - (4) Oxygen, **III-A-48**
      - (5) Sources of Oil and Hydrocarbons in the NPR-A, **III-A-49**
      - (6) Indicator Hydrocarbons, **III-A-49**
      - (7) Federal Contaminated Sites, **III-A-49**
  - 3. Atmospheric Environment, **III-A-49**
    - a. Climate and Meteorology, **III-A-49**
    - b. Air Quality, **III-A-53**

- B. Biological Resources, **III-B-1**
  - 1. Special Areas and Special Management Zones, **III-B-1**
  - 2. Vegetation, **III-B-1**
  - 3. Fish, **III-B-2**
    - a. Freshwater Fish, **III-B-6**
    - b. Marine Fish, **III-B-6**
    - c. Migratory Fish, **III-B-8**
    - d. Commercial Fishing, **III-B-10**
  - 4. Birds, **III-B-11**
    - a. Loons and Waterfowl, **III-B-15**
      - (1) Loons, **III-B-15**
      - (2) Tundra Swan, **III-B-15**
      - (3) Brant, **III-B-15**
      - (4) Greater White-fronted Goose, **III-B-23**
      - (5) Other Geese, **III-B-27**
      - (6) Ducks, **III-B-27**
    - b. Shorebirds, **III-B-33**
      - (1) Plovers, **III-B-35**
      - (2) Sandpipers, **III-B-35**
    - c. Passerines, **III-B-35**
    - d. Raptors, **III-B-35**
      - (1) Arctic Peregrine Falcon, **III-B-35**
      - (2) Gyrafalcon, **III-B-38**
      - (3) Rough-Legged Hawk, **III-B-38**
      - (4) Other Raptors, **III-B-38**
    - e. Seabirds, **III-B-38**
    - f. Ptarmigan, **III-B-38**
  - 5. Mammals, **III-B-38**
    - a. Terrestrial Mammals, **III-B-38**
      - (1) Caribou, **III-B-38**
        - (a) Population Status and Range, **III-B-38**
        - (b) Migration, **III-B-39**
        - (c) Calving Grounds, **III-B-39**
        - (d) Summer Distribution and Insect-Relief Areas, **III-B-39**
        - (e) Winter-Range Use and Distribution, **III-B-42**
      - (2) Muskoxen, **III-B-42**
      - (3) Moose, **III-B-42**
      - (4) Grizzly Bear, **III-B-** 42
      - (5) Wolf, **III-B-43**
      - (6) Wolverine, **III-B-43**
      - (7) Arctic Fox, **III-B-43**
    - b. Marine Mammals, **III-B-43**
      - (1) Ringed Seal, **III-B-43**
      - (2) Bearded Seal, **III-B-45**
      - (3) Spotted Seal, **III-B-45**
      - (4) Polar Bear, **III-B-45**
      - (5) Belukha Whale, **III-B-46**
  - 6. Endangered and Threatened Species, **III-B-46**
    - a. Migratory Species Occurring in and Adjacent to the Planning Area, **III-B-46**
      - (1) Bowhead Whale, **III-B-46**
      - (2) Spectacled Eider, **III-B-47**
      - (3) Steller's Eider, **III-B-49**
    - b. Migratory Species Occurring Along the Marine Transportation Routes (Washington, Oregon, and California), **III-B-52**

- C. Social Systems, **III-C-1**
  - 1. Economy, **III-C-1**
    - a. NSB Revenues and Expenditures, **III-C-1**
    - b. NSB Employment, **III-C-1**
    - c. Subsistence as a Part of the NSB Economy, **III-C-2**
    - d. State Revenues, **III-C-4**
    - e. Southcentral Alaska Employment, **III-C-4**
    - f. Recreation Employment, **III-C-4**
  - 2. Cultural Resources, **III-C-5**
  - 3. Subsistence, **III-C-7**
    - a. Annual Cycle of Harvest Activities, **III-C-8**
    - b. Community Subsistence-Harvest Patterns, **III-C-8**
      - (1) Barrow, **III-C-12**
      - (2) Atqasuk, **III-C-19**
      - (3) Nuiqsut, **III-C-23**
      - (4) Other Villages, **III-C-29**
      - (5) Subsistence Access Routes, **III-C-31**
  - 4. Sociocultural Systems, **III-C-31**
    - a. Characteristics of the Population, **III-C-37**
    - b. Social Characteristics of the Communities, **III-C-37**
      - (1) Barrow, **III-C-37**
      - (2) Atqasuk, **III-C-38**
      - (3) Nuiqsut, **III-C-38**
    - c. Social Organization, **III-C-38**
    - d. Cultural Values, **III-C-38**
    - e. Institutional Organization of the Communities, **III-C-40**

        - f. Other Issues, **III-C-40**
    - 5. Land Uses and Coastal Management, **III-C-40**
        - a. Land Ownership and Uses, **III-C-40**
            - (1) Land Ownership, **III-C-40**
            - (2) Land Uses, **III-C-41**
        - b. Coastal Zone Management, **III-C-42**
            - (1) Alaska Coastal Management Program (ACMP), **III-C-42**
            - (2) NSB Coastal Management Program, **III-C-44**
            - (3) NSB Land Management, **III-C-45**
    - 6. Recreation and Visual, **III-C-45**
        - a. Recreation, **III-C-45**
            - (1) Recreation Resource Values and Use, **III-C-45**
            - (2) Existing Recreation Developments, **III-C-49**
            - (3) Recreation Experience Opportunities, **III-C-52**
            - (4) Wilderness, **III-C-52**
        - b. Visual, **III-C-52**
    - 7. Transportation, **III-C-53**
        - a. Road Systems, **III-C-53**
        - b. Aviation Systems, **III-C-54**
        - c. Marine Transportation Systems, **III-C-54**
        - d. Pipeline Systems, **III-C-56**
        - e. NPR-A Facilities, **III-C-56**
        - f. Ice Roads, **III-C-59**

IV. ENVIRONMENTAL CONSEQUENCES, IV-A-1

- A. Basic Assumptions for Effects Assessment and Format, **IV-A-1**
    - 1. Ground-Impacting-Management Actions, **IV-A-2**
        - a. Activities Other Than Oil and Gas Exploration and Development, **IV-A-3**
        - b. Oil and Gas Exploration and Development Activities, **IV-A-6**
        - c. Seismic Operations, **IV-A-29**
    - 2. Oil Spills, **IV-A-30**
        - a. Estimated Planning Area Crude-Oil Spills, **IV-A-31**
        - b. Refined-Oil Spills, **IV-A-36**
        - c. Cumulative Case, **IV-A-36**
    - 3. Fate and Behavior of Oil Spills, **IV-A-36**
    - 4. Spill-Prevention and Response, **IV-A-38**
    - 5. Major Projects Considered in the Cumulative Case, **IV-A-38**
        - a. Resource Contribution of the Northeast NPR-A Planning Area to the Cumulative Case, **IV-A-38**
        - b. Current and Projected North Slope Oil Production, **IV-A-39**
        - c. Past and Projected State Oil and Gas Lease Sales, **IV-A-39**
        - d. OCS Lease-Sale Activity and Contribution to the Cumulative Case, **IV-A-39**
        - e. Infrastructure and Transportation, **IV-A-41**
        - f. Trans-Alaska Gas System (TAGS), **IV-A-41**
        - g. Tanker Traffic and Routes, **IV-A-41**
    - 6. Additional Background Assumptions, **IV-A-44**
        - a. Environmental Justice, **IV-A-44**
        - b. Sacred Sites, **IV-A-44**
        - c. Energy Requirements and conservation Potential of Various Alternatives and Mitigation Measures, **IV-A-44**

- B. Alternative A, **IV-B-1**
    - 1. Soils, **IV-B-1**
    - 2. Paleontological Resources, **IV-B-1**
    - 3. Water Resources, **IV-B-2**
    - 4. Water Quality, **IV-B-2**
    - 5. Air Quality, **IV-B-3**
    - 6. Vegetation, **IV-B-3**
    - 7. Fish, **IV-B-5**
        - a. Effects of Disturbance, **IV-B-5**
        - b. Effects of Spills, **IV-B-5**
    - 8. Birds, **IV-B-6**
        - a. Effects of Disturbance, **IV-B-6**
        - b. Effects of Spills, **IV-B-9**
    - 9. Mammals, **IV-B-10**
        - a. Terrestrial Mammals, **IV-B-10**
        - b. Marine Mammals, **IV-B-11**
    - 10. Endangered and Threatened Species, **IV-B-12**
        - a. Consultation Assumptions, **IV-B-12**
        - b. Ground Impacting Activities, **IV-B-13**
    - 11. Economy, **IV-B-15**
        - a. Activities Other than Oil and Gas Exploration and Development, **IV-B-15**
        - b. Oil and Gas Exploration and Development Activities, **IV-B-15**
    - 12. Cultural Resources, **IV-B-16**
    - 13. Subsistence-Harvest Patterns, **IV-B-16**
        - a. Ground Impacting Activities, **IV-B-16**
        - b. Effects on Subsistence Species, **IV-B-17**
        - c. Effects on Communities, **IV-B-17**
    - 14. Sociocultural Systems, **IV-B-17**
        - a. Activities Other Than Oil and Gas Exploration and Development, **IV-B-17**
        - b. Population and Employment, **IV-B-17**
        - c. Subsistence-Harvest Patterns, **IV-B-18**
        - d. Effects on Barrow, Atqasuk, and Nuiqsut, **IV-B-18**

15. Coastal Zone Management, **IV-B-18**
16. Recreation and Visual Resources, **IV-B-19**

C. Alternative B, **IV-C-1**
  1. Soils, **IV-C-1**
    a. Activities Other than Oil and Gas Exploration and Development, **IV-C-1**
    b. Oil and Gas Exploration and Development Activities, **IV-C-1**
  2. Paleontological Resources, **IV-C-2**
    a. Ground-Impacting-Management Actions, **IV-C-2**
  3. Water Resources, **IV-C-3**
    a. Activities Other than Oil and Gas Exploration and Development, **IV-C-3**
    b. Oil and Gas Exploration and Development Activities, **IV-C-3**
  4. Water Quality, **IV-C-5**
    a. Activities Other Than Oil and Gas Exploration and Development, **IV-C-5**
    b. Oil and Gas Exploration and Development Activities, **IV-C-5**
  5. Air Quality, **IV-C-10**
    a. Activities Other than Oil and Gas Exploration and Development, **IV-C-10**
    b. Oil and Gas Exploration and Development Activities, **IV-C-10**
  6. Vegetation, **IV-C-12**
    a. Exploration, **IV-C-12**
    b. Development, **IV-C-13**
  7. Fish, **IV-C-15**
    a. Activities Other Than Oil and Gas Exploration and Development, **IV-C-15**
    b. Oil and Gas Exploration and Development Activities, **IV-C-15**
  8. Birds, **IV-C-18**
    a. Activities Other than Oil and Gas Exploration and Development, **IV-C-18**
    b. Oil and Gas Exploration and Development Activities, **IV-C-19**
  9. Mammals, **IV-C-25**
    a. Terrestrial Mammals, **IV-C-25**
      (1) Activities Other than Oil and Gas Exploration and Development, **IV-C-25**
      (2) Oil and Gas Exploration and Development Activities, **IV-C-25**
    b. Marine Mammals, **IV-C-32**
      (1) Activities Other than Oil and Gas Exploration and Development, **IV-C-32**
      (2) Oil and Gas Exploration and Development Activities, **IV-C-32**
  10. Endangered and Threatened Species, **IV-C-33**
    a. Activities Other Than Oil and Gas Exploration and Development, **IV-C-33**
    b. Oil and Gas Exploration and Development Activities, **IV-C-33**
      (1) Effects on the Bowhead Whale, **IV-C-34**
      (2) Effects on the Spectacled and Steller's Eiders, **IV-C-36**
    c. Effects of an Oil Spill on Listed and Proposed Listed Species along the Transportation Route, **IV-C-40**
  11. Economy, **IV-C-42**
    a. Activities Other Than Oil and Gas Exploration and Development, **IV-C-42**
    b. Oil and Gas Exploration and Development Activities, **IV-C-42**
  12. Cultural Resources, **IV-C-45**
    a. Ground-Impacting-Management Actions, **IV-C-45**
  13. Subsistence-Harvest Patterns, **IV-C-46**
    a. Ground-Impacting-Management Actions, **IV-C-48**
    b. Effects on Subsistence Species, **IV-C-49**
    c. Effects on Communities, **IV-C-51**
  14. Sociocultural Systems, **IV-C-57**
    a. Parameters of this Analysis, **IV-C-58**
    b. Ground-Impacting-Management Actions, **IV-C-59**
    c. Population and Employment, **IV-C-60**
    d. Subsistence-Harvest Patterns, **IV-C-60**
    e. Effects on Barrow, Atqasuk, and Nuiqsut, **IV-C-60**
  15. Coastal Zone Management, **IV-C-65**
    a. Activities Other than Oil and Gas Exploration and Development, **IV-C-65**
    b. Oil and Gas Exploration and Development Activities, **IV-C-66**
  16. Recreation and Visual Resources, **IV-C-72**
    a. Activities Other than Oil and Gas Exploration and Development, **IV-C-72**
    b. Oil and Gas Exploration and Development Activities, **IV-C-72**

D. Alternative C, **IV-D-1**
  1. Soils, **IV-D-1**
  2. Paleontological Resources, **IV-D-2**
  3. Water Resources, **IV-D-3**
  4. Water Quality, **IV-D-3**
  5. Air Quality, **IV-D-** 5
  6. Vegetation, **IV-D-5**
  7. Fish, **IV-D-6**
  8. Birds, **IV-D-8**
  9. Mammals, **IV-D-9**
    a. Terrestrial Mammals, **IV-D-9**

9. Mammals, **IV-J-2**
    a. Terrestrial Mammals, **IV-J-2**
    b. Marine Mammals, **IV-J-2**
10. Endangered and Threatened Species, **IV-J-2**
11. Economy, **IV-J-2**
12. Cultural Resources, **IV-J-2**
13. Subsistence-Harvest Patterns, **IV-J-2**
14. Sociocultural Systems, **IV-J-2**
15. Coastal Zone Management, **IV-J-2**
16. Recreation and Visual Resources, **IV-J-2**

K. Effects of Natural Gas Development And Production, **IV-K-1**
1. Soils, **IV-K-1**
2. Paleontological Resources, **IV-K-1**
3. Water Resources, **IV-K-1**
4. Water Quality, **IV-K-1**
5. Air Quality, **IV-K-1**
6. Vegetation, **IV-K-2**
7. Fish, **IV-K-2**
8. Birds, **IV-K-2**
9. Mammals, **IV-K-2**
    a. Terrestrial Mammals, **IV-K-2**
    b. Marine Mammals, **IV-K-2**
10. Endangered and Threatened Species, **IV-K-2**
11. Economy, **IV-K-2**
12. Cultural Resources, **IV-K-3**
13. Subsistence-Harvest Patterns, **IV-K-3**
14. Sociocultural Systems, **IV-K-3**
15. Coastal Zone Management, **IV-K-3**
16. Recreation and Visual Resources, **IV-K-3**

L. Effects of a Low Probability, High Effects, Oil-Spill Event, **IV-L-1**
1. Soils, **IV-L-1**
2. Paleontological Resources, **IV-L-1**
3. Water Resources, **IV-L-1**
4. Water Quality, **IV-L-2**
5. Air Quality, **IV-L-2**
6. Vegetation, **IV-L-2**
7. Fish, **IV-L-2**
8. Birds, **IV-L-2**
9. Mammals, **IV-L-3**
    a. Terrestrial Mammals, **IV-L-3**
    b. Marine Mammals, **IV-L-3**
10. Endangered and Threatened Species, **IV-L-3**
11. Economy, **IV-L-3**
12. Cultural Resources, **IV-L-4**
13. Subsistence-Harvest Patterns, **IV-L-4**
14. Sociocultural Systems, **IV-L-4**
15. Coastal Zone Management, **IV-L-4**
16. Recreation and Visual Resources, **IV-L-5**

V. REVIEW AND ANALYSIS OF COMMENTS RECEIVED (RESERVED FOR THE FEIS)

VI. CONSULTATION AND COORDINATION, VI-
A. Introduction, **VI-1**
B. Formal Scoping, **VI-1**
C. Workshops and Meetings, **VI-1**
D. Peer Reviews, **VI-2**
E. State and NSB Cooperation, **VI-2**
F. Publications, **VI-2**
G. Agencies and Organizations Consulted, **VI-2**
H. List of Preparers, **VI-3**

APPENDICES

A. Inventory and Monitoring
B. Effects of a Low Probability, High-Effects Very Large Oil-Spill Event
C. Endangered and Threatened Species Consultation
D. Section 810 of ANILCA Findings and Evaluations
E. Proceedings of the Teshekpuk Lake Area Caribou/Waterfowl Impacts Analysis Workshop
F. Northeast NPR-A Integrated Activity Plan EIS Subsistence Impact Analysis Workshop Proceedings
G. Wild and Scenic Rivers — Management Objectives and Standards and Assessment Process
H. Visual Resource Management
I. The Inupiat People's History and Future with regard to the National Petroleum Reserve-Alaska (NPR-A) A 1997 Perspective from the North Slope Borough

BIBLIOGRAPHY

LIST OF FIGURES AND TABLES

Figures

I.1 Teshekpuk Lake and Colville River Special Areas, **I-3**
I.2 National Petroleum Reserve-Alaska (NPR-A), **I-4**
I.3 National Petroleum Reserve-Alaska (NPR-A), **I-5**
I.4 Planning Area, **I-6**
I.5 Inupiat map, **I-7**

II.B.1 Teshekpuk Lake watershed LUEA, **II-4**
II.B.2 Goose molting habitat LUEA, **II-5**
II.B.3 Spectacled eider nesting concentrations LUEA, **II-6**
II.B.4 Teshekpuk Lake caribou habitat LUEA, **II-7**
II.B.5 Fish habitat LUEA, **II-8**
II.B.6 Colville River raptor, passerine, and moose area LUEA, **II-9**

III.B.4-13 Density of oldsquaw, **III-B-29**
III.B.4-14 Density of king eiders, **III-B-30**
III.B.4-15 Density of scaup, **III-B-31**
III.B.4-16 Density of scoters, **III-B-32**
III.B.4-17 Density of shorebirds on the Arctic coastal plain, **III-B-34**
III.B.4-18 Peregrine falcon, gyrfalcon, rough-legged hawk and golden eagle nesting sites, **III-B-36**
III.B.4-19 Density of Sabine's gulls, **III-B-37**
III.B.5.a-1 Caribou data, **III-B-40**
III.B.5.a-2 Moose, muskox, and wolverine data, **III-B-41**
III.B.5.b-1 Nonendnagered marine mammal habitats, **III-B-44**
III.B.6-1 Spectacled eider density 1992-1996, **III-B-48**
III.B.6-2 Steller's eider sightings by year, all recorded sightings 1989-1995, **III-B-50**
III.B.6-3 Steller's eider sightings in planning area, all recorded sightings 1989-1995, **III-B-51**

III.C.1-1 North Slope Borough labor force, 1975-1995: workers residing permanently in the North Slope Borough, **III-C-3**
III.C.1-2 North Slope Borough nonagricultural employment, 1985-1995: workers working in the North Slope Borough, **III-C-3**
III.C.1-3 North Slope Borough nonagricultural employment by selected industry type, 1991-1994, **III-C-3**
III.C.2-1 Cultural resource sites, **III-C-5**
III.C.3-1 Community subsistence land use areas for all subsistence resources (described in 1979), **III-C-9**
III.C.3-2 Subsistence areas for Barrow (described in 1979) for wildfowl, caribou, moose, fish, and whales, **III-C-14**
III.C.3-3 Barrow annual subsistence cycle, **III-C-15**
III.C.3-4 Barrow household consumption of meat, fish, and birds from subsistence activities, **III-C-15**
III.C.3-5 Barrow household expenditures on subsistence activities, **III-C-15**
III.C.3-6 Subsistence areas for Atqasuk (described in 1979) for wildfowl, caribou, moose, and fish, **III-C-20**
III.C.3-7 Atqasuk annual subsistence cycle, **III-C-21**
III.C.3-8 Atqasuk household consumption of meat, fish, and birds from subsistence activities, **III-C-21**
III.C.3-9 Atqasuk household expenditures on subsistence activities, **III-C-21**
III.C.3-10 Subsistence areas for Nuiqsut (described in 1979) for wildfowl, caribou, moose, fish, and whales, **III-C-26**
III.C.3-11 Nuiqsut annual subsistence cycle, **III-C-27**
III.C.3-12 Nuiqsut household consumption of meat, fish, and birds from subsistence activities, **III-C-27**
III.C.3-13 Nuiqsut household expenditures on subsistence activities, **III-C-27**
III.C.3-14 Subsistence areas for Anaktuvuk Pass (described in 1979) for wildfowl, caribou, moose, and fish, **III-C-30**
III.C.3-15 Nuiqsut subsistence harvest place names and number of times each location was used July 1, 1994 to June 30, 1995, **III-C-32**
III.C.3-16 Historical subsistence access routes, **III-C-33**
III.C.3-17 Barrow subsistence harvest sites1987-1990, **III-C-34**
III.C.3-18 Barrow fixed hunting and fishing camp locations, **III-C-35**
III.C.3-19 Atqasuk subsistence harvest place names and number of times each harvest location was used by Atqasuk hunters July 1, 1994 to June 30, 1995, **III-C-36**
III.C.5.a-1 Land status, **III-C-43**
III.C.6-1 Wild and scenic river inventory river reaches, **III-C-50**
III.C.6-2 Rivers reviewed for wild and scenic river values, **III-C-51**
III.C.7-1 North Slope oil fields road network, **III-C-55**
III.C.7-2 North Slope oil fields pipeline network, **III-C-57**
III.C.7-3 NPR-A air strips, **III-C-58**

IV.A.1.b-1 Layout of Alpine Field, **IV-A-12**
IV.A.1.b-2 Staging areas for NPR-A activities, **IV-A-13**
IV.A.1.b-3 Gravel pad construction designs, **IV-A-15**
IV.A.1.b-4 Directional drilling from a surface location, **IV-A-15**
IV.A.1.b-5 Processing drilling mud and cuttings for disposal, **IV-A-17**
IV.A.1.b-6 Subsurface injection of mud and cuttings, **IV-A-19**

IV.A.1.b-7 Future pipeline corridors, **IV-A-22**
IV.A.1.b-8 Typical pipeline construction, **IV-A-23**
IV.A.2 Alaska North Slope crude oil spill size distribution and the percent of spills <2 gallons, 5 gallons, and 25 gallons for the period 1989-1996, **IV-A-31**
IV.A.5-1 North Slope oil and gas fields, new discoveries, and proposed activities, **IV-A-40**
IV.A.5-2 General tanker routes and ports of entry, **IV-A-42**
IV.A.5-3 Potential Valdez to Far East tanker route, **IV-A-43**

Tables

II.D.1 Land use emphasis areas, **II-36**
II.D.2 Summary of the impacts of the alternatives on each resource, **II-41**

III.A.1.a(3)-1 Play resources in the NE NPR-A planning area, **III-A-25**
III.A.2.a-1 Summary of hydrologic data for streams in the NE planning unit, **III-A-44**
III.A.2.a-2 Summary of long-term stream-gaging data for North Slope streams outside the planning unit, **III-A-44**
III.A.2.a-3 Summary of hydrographic data for selected lakes in the planning unit, **III-A-44**
III.A.3.a-1 Climatic conditions in Alaska north of the Brooks Range, **III-A-50**
III.A.3.b-1 Relevant ambient-air-quality standards, **III-A-54**
III.A.3.b-2 Measured-air-pollutant concentrations at Prudhoe Bay, Alaska, 1986-1987, **III-A-54**

III.B.2-1 Summary of Land Cover Inside Planning Area Boundary, **III-B-5**
III.B.4-1 Status, occurrence, and estimated numbers and densities of selected bird species on the Arctic coastal plain, **III-B-12**
III.B.4-2 Numbers of geese recorded in the Teshekpuk Lake Goose Molting habitat area during aerial surveys over a 15-year period, **III-B-12**
III.B.4-3 Approximate chronology of activities for selected birds nesting on the Arctic coastal plain, **III-B-14**
III.B.4-4 Breeding status, relative abundance on the Arctic coastal plain, and range of estimated densities for shorebird species expected to breed in the planning area, **III-B-14**

III.C.3-1 Resources used in Barrow, Kaktovik, and Nuiqsut, **III-C-10**
III.C.3-2 Proportion of Inupiat household food obtained from subsistence activities, 1977, 1988, and 1993, **III-C-11**
III.C.3-3 Participation in successful harvests of selected resources (percentage of households per resource), **III-C-11**
III.C.3-4 Individual subsistence resource percentages of average total community annual subsistence harvest, **III-C-11**
III.C.3-5 Number of animals harvested, Barrow (1987-90) (weighted), **III-C-16**
III.C.3-6 Barrow 1989 Subsistence-Harvest Summary for Marine Mammals, Terrestrial Mammals, Fish, and Birds, **III-C-17**
III.C.3-7 Atqasuk household characteristics, 1988, by levels of subsistence participation, **III-C-22**
III.C.3-8 Subsistence harvest by month for Atqasuk, July 1, 1994, to June 30, 1995, **III-C-23**
III.C.3-9 Nuiqsut 1993 subsistence-harvest summary for marine mammals, terrestrial mammals, fish, and birds, **III-C-28**
III.C.3-10 Subsistence harvest by month for Nuiqsut, July 1, 1994, to June 30, 1995, **III-C-29**
III.C.6-1 WSR River eligibility summary, **III-C-52**

IV.A-1 Areas: (a) Alternatives and (b) Features, **IV-A-2**
IV.A.1.a-1 Management actions with potential impacts on the ground, **IV-A-3**
IV.A.1.b-1 Development timeframe for a typical oil field, **IV-A-8**
IV.A.1.b-2 Exploration-only schedule for the first sale, **IV-A-25**
IV.A.1.b-3 Development schedule for the first sale, **IV-A-25**
IV.A.1.b-4 Resource estimates for the first sale in each alternative, **IV-A-27**
IV.A.1.b-5 Levels of activities for the first sale under each alternative, **IV-A-27**
IV.A.1.b-6 Resource estimates for multiples sales under the alternatives, **IV-A-27**
IV.A.1.b-7 Levels of activities for multiple sales under the alternatives, **IV-A-27**

IV.A.2-1 Estimated Alaska North Slope crude oil spill rate for the years 1989-1996, **IV-A-32**

IV.A.2-2a Oil spill occurrence estimates for crude oil spills > 1 gallon resulting over the assumed production life of the NE NPR-A planning area first sale, **IV-A-32**

IV.A.2-2b Oil spill occurrence estimates for crude oil spills > 1 gallon resulting over the assumed production life of the NE NPR-A planning area multiple sales, **IV-A-32**

IV.A.2-3a Estimated crude oil spill size distribution resulting over the assumed production life of the NE NPR-A planning area first sale, **IV-A-32**

IV.A.2-3b Estimated crude oil spill size distribution resulting over the assumed production life of the NE NPR-A planning area multiple sales, **IV-A-32**

IV.A.2-4a Oil spill occurrence estimates for TAPS oil spills > 1 gallon resulting from NPR-A over the assumed production life of the NE NPR-A planning area first sale, **IV-A-33**

IV.A.2-4b Oil spill occurrence estimates for TAPS oil spills > 1 gallon resulting from NPR-A over the assumed production life of the NE NPR-A planning area multiple sales, **IV-A-33**

IV.A.2-5a Oil spill occurrence estimates for TAPS tanker spills > 1,000 bbl resulting from NPR-A resources over the assumed production life of the NE NPR-A planning area first sale, **IV-A-33**

IV.A.2-5b Oil spill occurrence estimates for TAPS tanker spills > 1,000 bbl resulting from NPR-A resources over the assumed production life of the NE NPR-A planning area multiple sales, **IV-A-33**

IV.A.2-6a Oil spill occurrence estimates for refined oil spills > 1 gallon resulting over the assumed production life of the NPR-A planning area first sale, **IV-A-34**

IV.A.2-6b Oil spill occurrence estimates for refined oil spills > 1 gallon resulting over the assumed production life of the NPR-A planning area multiple sales, **IV-A-34**

IV.A.2-7 Oil spill rates and spill size categories used in the estimation of oil spills for the cumulative case, **IV-A-35**

IV.A.2-8 Cumulative case oil spill occurrence estimates > 1 gallon resulting from foreseeable operations over the assumed production life of the NE NPR-A planning area, **IV-A-35**

IV.A.2-9 Cumulative case summary: oil spill occurrence estimates, **IV-A-36**

IV.A.5-1 Resource and reserve estimates used for analytical purposes in the cumulative case, **IV-A-39**

IV.B.6-1 Proportion of vegetative impacts to each land cover category, **IV-B-4**

IV.C-1 LUEA's status for oil and gas leasing under Alternative B, **IV-C-1**

IV.C.11-1 Summary of employment forecasts, Alternative B, **IV-C-43**

IV.C.11-2 Summary of population forecasts, Alternative B, **IV-C-43**

IV.D-1 LUEA's status for oil and gas leasing under Alternative C, **IV-D-1**

IV.D.11-1 Summary of employment forecasts, Alternative C, **IV-D-14**

IV.D.11-2 Summary of population forecasts, Alternative C, **IV-D-14**

IV.E-1 LUEA's status for oil and gas leasing under Alternative D, **IV-E-1**

IV.E.11-1 Summary of employment forecasts, Alternative D, **IV-E-15**

IV.E.11-2 Summary of population forecasts, Alternative D, **IV-E-15**

IV.F-1 LUEA's status for oil and gas leasing under Alternative E, **IV-F-1**

IV.F.11-1 Summary of employment forecasts, Alternative E, **IV-F-18**

IV.F.11-2 Summary of population forecasts, Alternative E, **IV-F-18**

IV.G-1 Cumulative onshore area (acres) affected by gravel extraction and fill for existing oilfields and planned projects on the North Slope, **IV-G-1**

IV.J-1 Resource estimates by alternative: first and multiple sales

List of Acronyms and Symbols

AAC	Alaska Administrative Code
AADT	Annual Average Daily Traffic (count)
ACI	Alaska Consultants, Inc.
ACMA	Alaska Coastal Management Act
ACMP	Alaska Coastal Management Program
ADCRA	Alaska Dept. of Community and Regional Affairs (State)
ADEC	Alaska Department of Environmental Conservation (State)
ADF&G	Alaska Dept. of Fish and Game (State)
ADGC	Alaska Dept. of Governmental Coordination
ADNR	Alaska Dept. of Natural Resources
ADOL	Alaska Dept. of Labor (State)
AEWC	Alaska Eskimo Whaling commission
AMSA	area meriting special attention
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
ANWR	Arctic National Wildlife Refuge
AO	Authorized Officer (BLM)
API	American Petroleum Institute
AS	Alaska Statutes
ASRC	Arctic Slope Regional Corp.
ATV	all-terrain vehicle
bbl	barrel
Bbbl	billion barrels
bcfd	billion cubic feet per day
BLM	Bureau of Land Management (Federal)
BLS	Bureau of Labor Statistics
BOE	barrels of oil equivalent
CAH	Central Arctic (caribou) Herd
CDF&G	California Department of Fish and Game (State)
CFR	Code of Federal Regulations
CIP	capital improvement project
CIRI	Cook Inlet Region, Inc. (check this)
cm	centimeter
CMP	Coastal Management Program
CO	carbon monoxide
COE	Corps of Engineers (US Army)
CRREL	Cold Regions Research Lab (US Army)
CRSA	Colville River Special Area
CZMA	Coastal Zone Management Act
DEC	Dept. of Environmental Conservation (State)
DEIS	draft EIS
DEW	Distant Early Warning (Line System)
DNR	Alaska Department of Natural Resources (State)
DU	Ducks Unlimited
DWM	Division of Wildlife Management (North Slope Borough)
EA	Environmental Assessment
EIS	Environmental Impact Statement
E.O	Executive Order
ERA	environmental resource area
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
EVOS	*Exxon Valdez* oil spill
FC	fecal coliform
FR	*Federal Register*
FEIS	final EIS
FLPMA	Federal Land Policy and Management Act
ft	foot/feet
FWS	Fish and Wildlife Service (Federal)
FY	fiscal year
gal	gallon(s)
GLO	General Land Office
GMU	Game Management Unit (State of Alaska, Dept. of Fish and Game)
GRASP	Geologic Resource Assessment Program
GSA	General Services Administration (Federal)
ha	hectare(s)
IAP	integrated Activity Plan
in	inch
IRA	Indian Reorganization Act
ISER	Institute of Social and Economic Research
IWC	International Whaling Commission
JPO	Joint Pipeline Office
km	kilometer(s)
km^2	square kilometer(s)
LCU	lower Cretaceous unconformity
lb	pound(s)
LMR	Land Management Regulation
LOA	Letter of Authority
LNG	liquefied natural gas
LS	Land Segment
LUEA	Land Use Emphasis Area
Ma	mega-annum (million years)
m	meter(s)
m^2	square meter(s)
meq/l	milliequivalent per liter
mg	milligram(s)
mg/l	milligrams per liter
mi	mile(s)
mi^2	square mile(s)
MLRA	major land resource area
MMbbl	million barrels (of oil)
MMbpd	million barrels of oil per day
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service (Federal)
MSS	Multispectral Scanner
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service

NO	nitric oxide
NO_x	nitrogen oxides
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NPR-A	National Petroleum Reserve-Alaska
NPRPA	Naval Petroleum Reserves Production Act
NSB	North Slope Borough
NURE	National Uranium Resource Evaluation Program
OCRM	Office of Ocean and Coastal Resource Management (Federal)
OCS	Outer Continental Shelf
OSC	Oil Spill Coordinator
OSRA	Oil-Spill-Risk Assessment
PAH	Polyaromatic hydrocarbons
PCH	petroleum hydrocarbons
PET-4	Naval Petroleum Reserve Number 4
pH	measure of acidity in water
P.L.	Public Law
PM-10	particulate matter less than10 micrometers
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
PRESTO	Probabilistic Resource Estimates Offshore (model)
PSD	Prevention of Significant Deterioration (Program)
RAM	Rural Alaska Model
ROD	Record of Decision
SHPO	State Historic Preservation Officer
SMZ	Special Management Zone
SO_2	sulfur dioxide
SPOT	French Satellite Pour l'Observation de la Terre
SQRU	Scenic Quality Rating Unit
SRP	Special Recreation Permits
SS	Sea Segment
TAGS	Trans-Alaska Gas System
TAPS	Trans-Alaska Pipeline System
Tcf	trillion cubic feet
TERA	Troy Ecological Research Assocs
TLH	Teshekpuk Lake (caribou) Herd
TLSA	Teshekpuk Lake Special Area
TLUI	Traditional Land Use Inventory
TM	Thematic Mapper
UAA	University of Alaska, Anchorage
URUSA	Utukok River Uplands Special Area
USCG	U.S. Coast Guard
USDA	U.S. Dept. of Agriculture
USDOC	U.S. Dept. of Commerce
USDOD	U.S. Dept. of Defense
USDOI	U.S. Dept. of the Interior
USDOL	U.S. Dept. of Labor
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	volatile organic compounds
VSM	vertical support member
WAH	Western Arctic (caribou) Herd
WSR	Wild and Scenic Rivers
yd	yard(s)
Y-K Delta	Yukon-Kuskokwim Delta
$\geq$	Greater than or equal to
$\leq$	Less than or equal to
$>$	Greater than/more than
$<$	Less than
$\mu g/m^3$	micrograms per cubic meter
$\bar{x}$	statistical mean
°API	specific gravity of oil
°F	degrees Fahrenheit
LC_{50}	lethal dose at which half of the organisms die

SECTION I

INTRODUCTION

BLANK PAGE

I. INTRODUCTION

A. PURPOSE AND NEEDS: The Bureau of Land Management (BLM) initiated the Northeast National Petroleum Reserve-Alaska (NPR-A) Integrated Activity Plan Environmental Impact Statement (IAP EIS) to determine the appropriate multiple-use management of this 4.6-million-acre area. To do this, BLM is addressing in this IAP EIS two major questions. (1) What protections and enhanced management will be implemented for surface resources within the planning area? These resources include cultural, paleontological, subsistence, and recreation resources; fisheries; land; soils; vegetation; water; and wildlife. (2) Will the BLM conduct oil and gas lease sales in the planning area, and if so, what lands will be made available for leasing?

The BLM leased tracts in the NPR-A in 1982 and 1983 (all now expired) but received no acceptable bids in a lease sale in 1984. The agency found little interest in another lease sale in annual surveys of the oil industry in following years. Recently, however, interest has increased as industry infrastructure has come closer to the Reserve's boundary (Fig. III.A.1.a(2)-1). None of the Federal lands in the planning area are closed, that is withdrawn from oil and gas leasing, but they currently are unavailable for leasing because existing National Environmental Policy Act (NEPA) documentation is dated and no longer adequate. Should BLM determine to undertake leasing, this IAP EIS will form the basic NEPA documentation to authorize leasing, and it will identify those areas that will be available and unavailable for leasing.

This IAP EIS is undertaken to fulfill BLM's responsibilities to manage these lands under the authority of the Federal Land Policy and Management Act (FLPMA) and the Naval Petroleum Reserves Production Act of 1976 (NPRPA), as amended. The EIS also satisfies the requirements of NEPA, and will afford the public and government officials an opportunity to take a comprehensive look at the future management of the area, including the potential for oil and gas leasing and possible Wild and Scenic Rivers Act designations.

The authority for the management options in the EIS comes from several statutes, including NEPA, Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA), the Wild and Scenic Rivers Act, and particularly FLPMA and the NPRPA. Under FLPMA, the Secretary has broad authority to regulate the use, occupancy, and development of the public lands and to take whatever action is required to prevent unnecessary or undue degradation of the public lands. 43 U.S.C. § 1732.

Under the NPRPA, the Secretary of the Interior has the authority to conduct oil and gas leasing and development in the NPR-A (42 U.S.C. § 6508). The NPRPA also provided that the Secretary of the Interior "shall assume all responsibilities" for "any activities related to the protection of environmental, fish and wildlife, and historical or scenic values" (42 U.S.C. § 6503(b)). In addition, the Secretary is authorized to "promulgate such rules and regulations as he deems necessary and appropriate for the protection of such values within the reserve" (42 U.S.C. § 6503(b)). Furthermore, the NPRPA, as amended, contains special provisions that apply to any exploration or development activities within the Teshekpuk Lake area and any other areas "designated by the Secretary of the Interior containing any significant subsistence, recreational, fish and wildlife, or historical or scenic value" (42 U.S.C. §§ 6504(b), 6508). These provisions require that any oil and gas exploration or development within a special area "shall be conducted in a manner which will assure the maximum protection of such surface resources to the extent consistent with the requirements of [the] Act for the exploration of the reserve" (42 U.S.C. §§ 6504(b), 6508). Finally, oil and gas activities must include or provide for "conditions, restrictions, and prohibitions as the Secretary deems necessary or appropriate to mitigate reasonably foreseeable and significantly adverse effects on the surface resources of the NPR-A" (42 U.S.C. § 6508(1)). This IAP EIS will fulfill these statutory mandates.

The BLM manages its Alaska lands and their uses to ensure healthy and productive ecosystems and to fulfill the Federal Government's responsibility to convey lands to the State of Alaska and to Native corporations and individuals. The FLPMA, the Alaska Statehood Act, the Alaska Native Claims Settlement Act (ANCSA), and the Native Allotment Act require these ongoing actions. In addition to the management actions under consideration in this plan that further the goal of ensuring a healthy and productive ecosystem. BLM already is engaged in some inventory and monitoring actions to achieve this end. (Appendix A describes ongoing and anticipated inventory and monitoring efforts.) For example, for the past 4 years, BLM has worked with Ducks Unlimited to define the vegetative land cover of the NPR-A and is now working to link this habitat information with wildlife data compiled by the U.S. Department of the Interior, Fish and Wildlife Service and the State of Alaska, Department of Fish and Game. The BLM also is engaged in conveying lands to Natives of the North Slope. Specifically, within the planning area the agency is working to complete conveyance of Native Allotments to individual Natives and ANCSA-authorized lands to the Kuukpik Corporation (the ANCSA corporation for the village of Nuiqsut) and to the Arctic Slope Regional Corporation (the ANCSA corporation for the Natives of the North Slope). These inventory and conveyance actions are ongoing and will continue under all alternatives considered in this IAP EIS.

This plan addresses all aspects of management that arise from BLM's existing statutory authority in NPR-A. There are other potential management questions that this plan does not address. These include hard-rock mining, wilderness designations, and identification of lands appropriate for exchange. For further discussion of these and other management actions not addressed in this IAP EIS, see Section II.G.

B. BACKGROUND:

1. Administrative History of the National Petroleum Reserve-Alaska: In 1923, President Warren G. Harding created the Naval Petroleum Reserve Number 4, commonly called Pet-4, in northern Alaska as a defense measure. In an era in which naval armament around the world regularly appeared in newspaper headlines and the American Navy was converting its ships to oil power the President, in his Executive Order (E.O.) establishing Pet-4, noted that "the future supply of oil for the Navy is at all times a matter of national concern." He added that "there are large seepages of petroleum along the Arctic Coast of Alaska," but that existing laws to "promote development seem imperfectly applicable in the region because of its distance, difficulties, and large expense of development" (E.O. 311, Feb. 27, 1923). The E.O. withdrew the lands from the land and mineral laws for 6 years; later, the time limit was deleted. For more than a half a century thereafter, the Navy and the U.S. Geological Survey conducted petroleum exploration of the region.

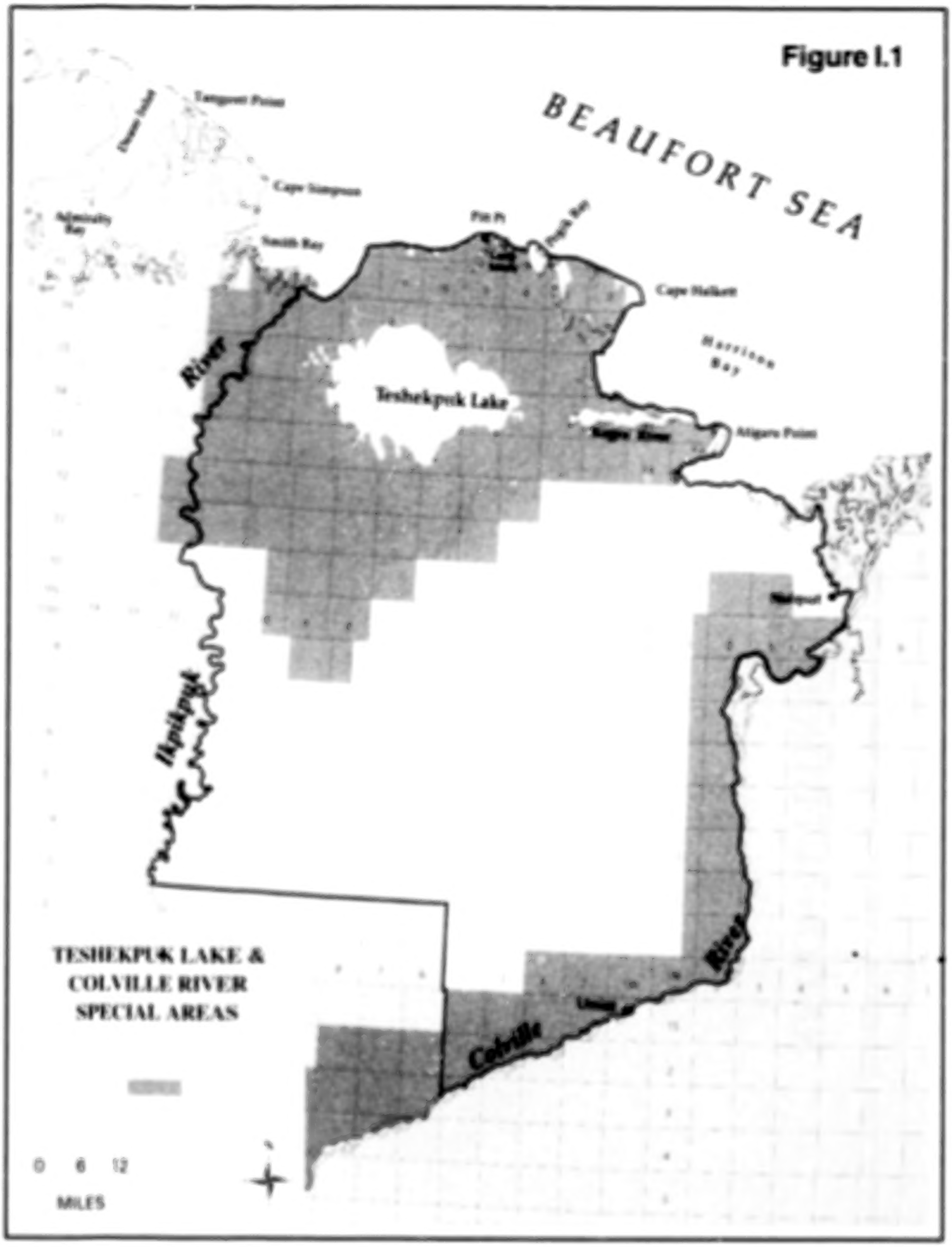
By the mid-1970's, the Navy's dependence on oil was dwarfed by that of the entire Nation's economy. At the same time, there was a rising environmental consciousness and interest in the great variety and richness of wildlife and other values in Pet-4. As a consequence, President Gerald Ford signed the NPRPA to develop Pet-4 and the other three Naval Petroleum Reserves "in a manner consistent with the total energy needs of the Nation" (P.L. 94-258, Apr. 5, 1976). The law transferred management of Pet-4 to the Secretary of the Interior and renamed it the National Petroleum Reserve-Alaska. The law withdrew NPR-A from appropriation under the land and mineral laws with three exceptions: (1) mineral materials (e.g., sand and gravel) for certain uses by Natives, (2) mineral materials and rights-of-way and other authorizations necessary to carry out the responsibilities of the NPRPA, and (3) surface lands previously selected by Alaska Native village corporations pursuant to Section 12 of the ANCSA. The law also prohibited petroleum production from NPR-A until authorized by Congress, an authorization that subsequently was granted in December 1980 (P.L. 96-514, Dec. 12, 1980).

2. Special Areas: The NPRPA stated that any petroleum exploration within "the Utukok River, the Teshekpuk Lake area, and other areas designated by the Secretary of the Interior containing any significant subsistence, recreational, fish and wildlife, or historical or scenic value, shall be conducted in a manner which will assure the maximum protection of such surface values to the extent consistent with the requirements of this Act for exploration of the reserve." Based on this authority, the Secretary in 1977 designated two Special Areas within the planning area (Fig. I.1) in which all activities were to "be conducted in a manner which will assure maximum protection" consistent with the NPRPA (Sec. III.B.1). The Teshekpuk Lake Special Area, which is almost entirely within the planning area, was created to protect migratory waterfowl and shorebirds. The Colville River Special Area, a third of which is in the planning area, was created to protect the arctic peregrine falcon, which at that time was an endangered species.

The Special Areas and their resources are the focus of many of the management actions and protective measures contained in the alternatives presented in Section II. These Special Areas and their resources are more fully described in Section III.B.1. None of the alternatives under consideration in this IAP EIS would eliminate any of the Special Areas; some of the alternatives propose adding to or creating new Special Areas.

3. Planning Area: Figures I.2 and I.3 locate the planning area in relation to the rest of Alaska and to Alaska's North Slope, respectively. Figure I.4 provides a general view of the planning area. Figure I.5 provides the same view with Inupiat place names. The IAP EIS covers Federal public lands within the planning boundary. The plan does not address lands owned by ANCSA regional or village corporations, mostly near the community of Nuiqsut; the surface lands within certified Native

Figure I.1

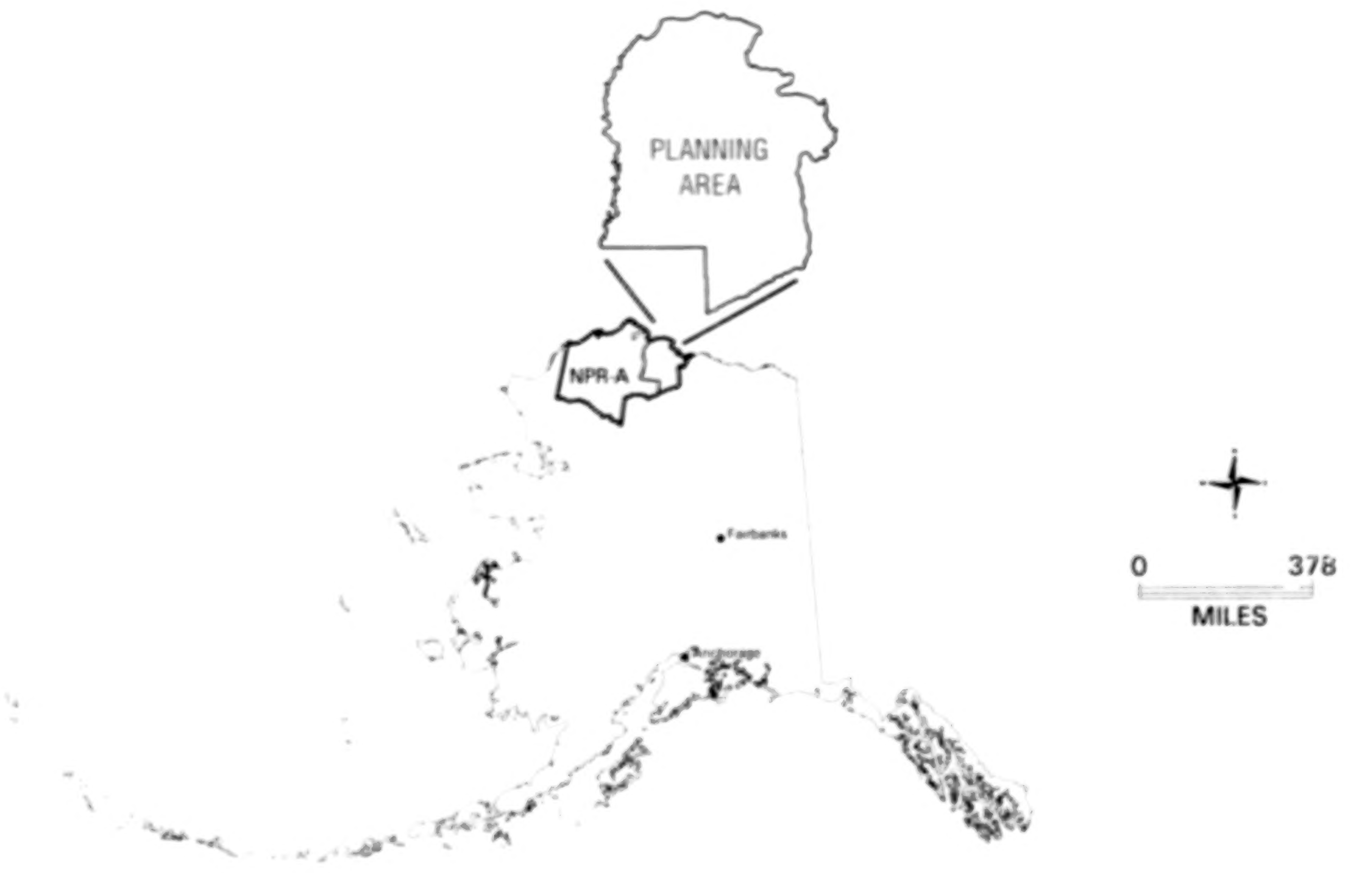


BEST COPY AVAILABLE

4

Figure I.2

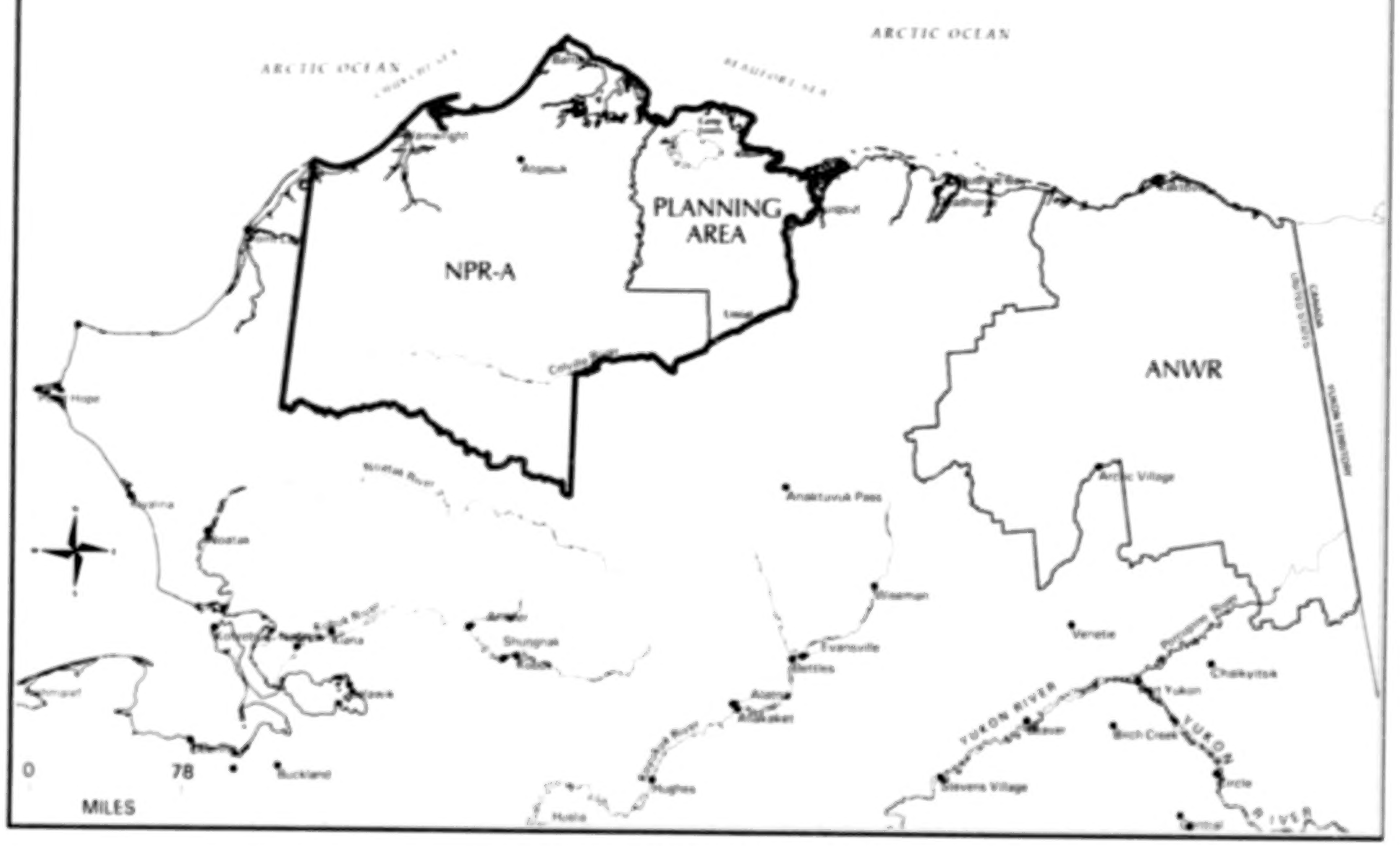
NATIONAL PETROLEUM RESERVE –ALASKA
(NPR-A)



BEST COPY AVAILABLE

Figure I.3

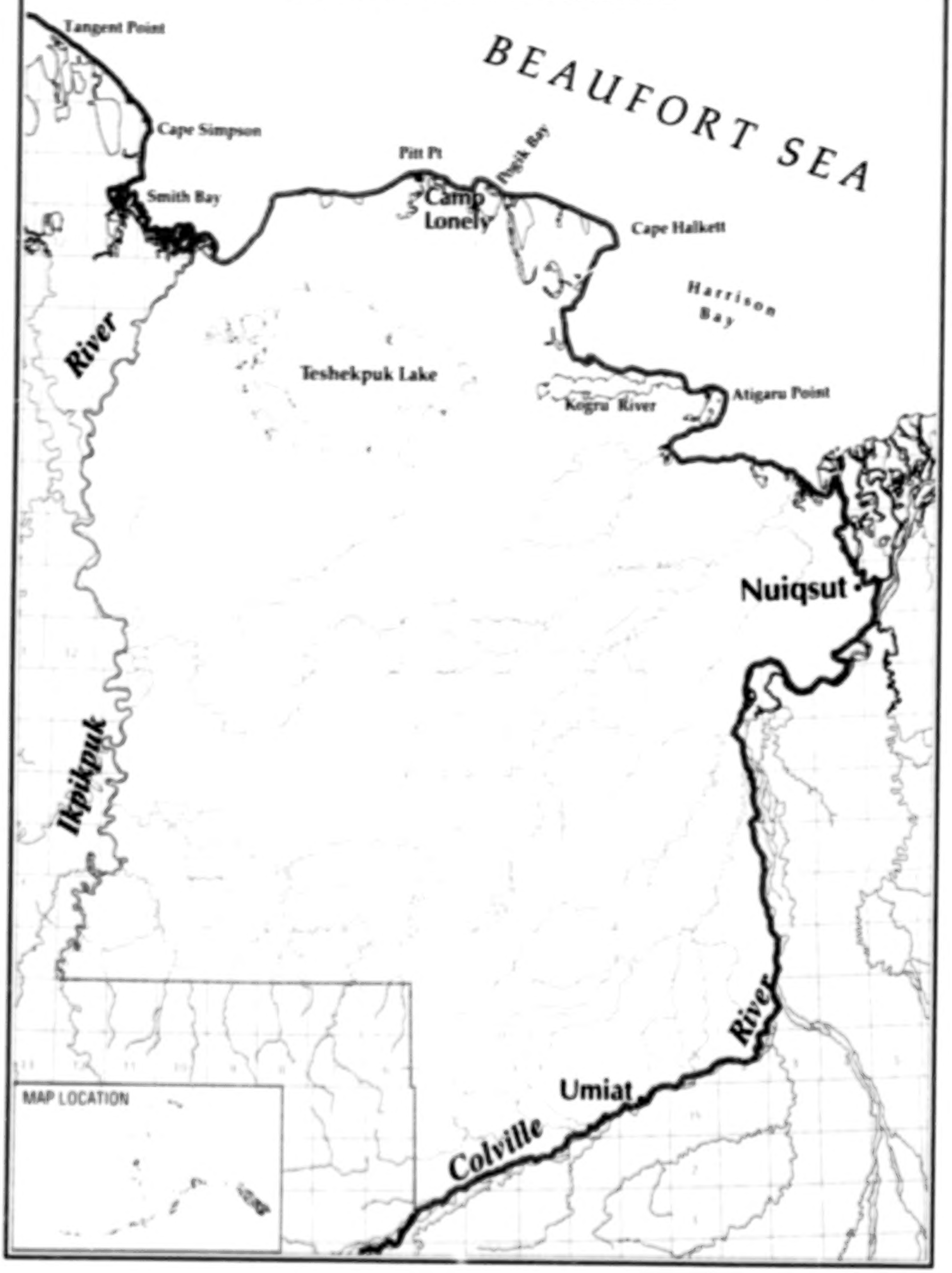
NATIONAL PETROLEUM RESERVE –ALASKA (NPR-A)



BEST COPY AVAILABLE

PLANNING AREA

Figure I.4

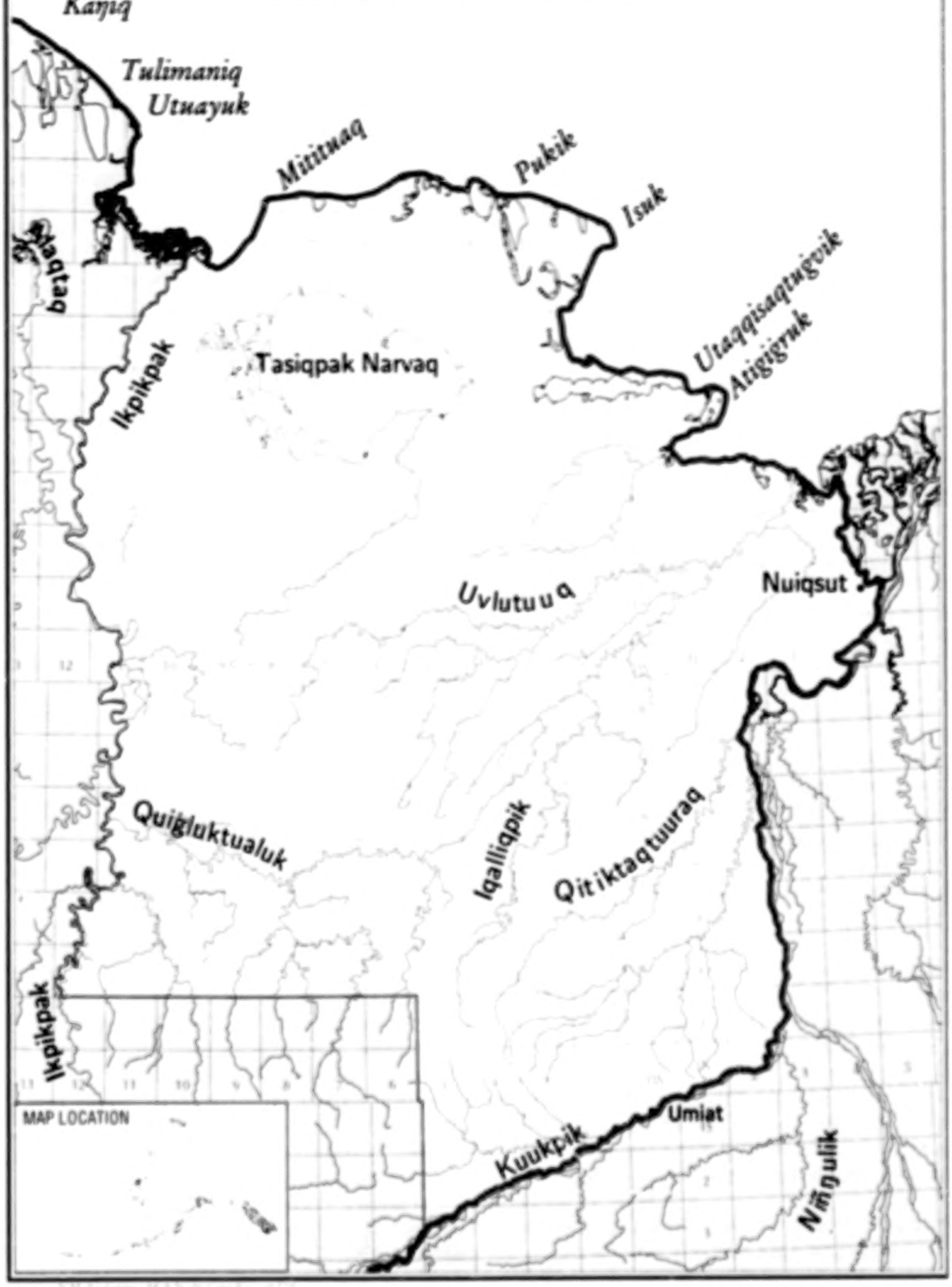


BEST COPY AVAILABLE

7

PLANNING AREA

Figure I.5



BEST COPY AVAILABLE

8

Allotments owned by private individuals; or the airstrip at Umiat, owned by the State of Alaska. For a more extensive discussion of land status, see Sec. III.C.5.a., which also contains a land status map.

A few technicalities regarding the boundary of the planning area are worth mentioning. The eastern boundary of the planning area is the eastern boundary of the NPR-A along the western bank of the Colville River. That boundary is defined in E.O. 3797-A as the "highest highwater mark . . . on the [western] bank," which the U.S. District Court in Alaska construed to be "on and along the bank at the highest level attained by the waters of the river when they reach and wash the bank without overflowing it" (*Alaska v. U.S.*; A78-069 Civ). Thus, neither the Colville River nor its bank immediately adjacent to the river are in the planning area. Most of the western boundary is along the eastern bank of the Ikpikpuk River, so that river also is outside the planning area. Finally, the U.S. Supreme Court in *U.S. v Alaska*, No. 84, Orig. decided on June 19, 1997, that the NPR-A included tidally influenced waters and that those waters did not transfer to the State at Statehood. This decision accounts for the depiction on Figure I.4 and I.5 of inlets and tidal waters between outlying islands and the mainland as part of NPR-A.

4. Relationship of the IAP/EIS to Past BLM Plans in the Planning Area: The Congress first authorized an oil and gas leasing program in the NPR-A in the Fiscal Year 1981 Appropriations Act (P.L. 96-514, Dec. 12, 1980). To meet the provisions of NEPA to conduct sales, the BLM completed an Environmental Assessment (EA) in 1981 and an EIS in 1983 (USDOI, BLM, 1983). The 1983 EIS deleted some areas from leasing and recommended stipulations, especially in areas with high surface values. (See Sec. III.B.1 for additional information on the 1983 EIS.) The final IAP adopted as a result of this environmental analysis will establish guidelines for future management of the planning area and will supercede management guidelines developed under the 1983 EIS.

The NPR-A has been the subject of several studies since its creation just over two decades ago. The NPRPA's Section 105(c) mandated studies of the resources of the NPR-A, which were published in 1978 and 1979. In 1985, the BLM completed separate habitat and mineral evaluations of the Teshekpuk Lake Special Area (USDOI, BLM, 1985a,b). The current planning effort draws on these previous studies as well as incorporating data from research and monitoring conducted since that time.

5. Process: A Notice of Intent to Plan and a Call for Nominations and Comments published in the *Federal Register* on February 13, 1997, launched the current BLM initiative in the northeastern NPR-A. The Notice and Call asked the public to help the agency identify issues and resources relevant to the planning effort and to any potential oil and gas leasing. It also asked oil companies to identify areas within the planning area in which they were interested. For a fuller description of the public outreach program BLM has engaged in to date, see Section VI.

This draft IAP/EIS is the result of the public input and analysis by multiagency participants in this process. Upon receiving the public's comments, BLM and the Minerals Management Service (MMS), which is assisting BLM to produce the environmental analyses, will reevaluate their analyses, respond to specific comments, and prepare a final IAP/EIS identifying a Proposed Action. The Proposed Action may be one of the alternatives offered in this plan or a mix of elements from the alternatives in this draft. For example, the Proposed Action might make the area identified in Alternative B available to oil and gas leasing but choose and Wild and Scenic River option proposed in Alternative D. After publishing the final IAP/EIS, the BLM will issue a Record of Decision (ROD) finalizing its decisions on future management in the planning area. The Final EIS/IAP is scheduled for midsummer 1998 and the ROD for August 1998.

Concurrent with the NEPA analysis, BLM, in cooperation with MMS, is analyzing geologic data, including massive amounts of seismic data. Should BLM determine to hold a lease sale, these data will assist the Federal Government to identify oil and gas lease tracts and establish appropriate values for acceptable bids. Substantial work on this "tract-evaluation process" will be completed prior to issuance of the ROD; additional work will be done after any lease sale to determine the acceptability of bids.

Additional management actions are required after issuance of the ROD. For example, creation of or additions to Special Areas would require action by the Secretary of the Interior, and establishment of a Wild and Scenic River would require congressional action.

If the ROD makes lands available for oil and gas leasing, a series of NEPA and tract-evaluation processes would ensue with each lease sale. If there is a sale, the first sale could occur in late 1998. For analysis purposes, the IAP/EIS assumes that all lands that the ROD determines should be available for leasing will be offered in the first sale. Readers should bear in mind, however, that the first sale may offer only part of the lands determined in the ROD to be available. Subsequent sales could offer additional available tracts for leasing as well as reoffer tracts not leased earlier. The timing of the second and subsequent sales will depend in part on the response to the first sale and the results of the exploration that follows. The BLM anticipates that this IAP/EIS will fulfill the NEPA requirements for the first sale. Prior to conducting each additional sale, the agency will conduct a NEPA analysis, tiering from the IAP/EIS. If the analysis in the IAP/EIS is deemed to be valid, the NEPA analysis for the second and subsequent sales may require only an administrative determination or an EA.

C. ISSUES: The BLM has sought to define the issues in the planning area through public participation and discussions with the State; the North Slope Borough (NSB), which is the borough government in which the planning area lies; and with other Federal Agencies. (The BLM's consultation and coordination efforts are further described in Section VI.) The BLM reviewed the concerns and questions raised during the public scoping process and integrated solutions to many of the issues into elements of the alternatives. The major issues addressed in the IAP/EIS are:

- **Oil and Gas Development in a Remote, Largely Undeveloped Area.** Most questions about the future management of the planning area revolve around whether BLM should offer oil and gas leases and, if so, with what restrictions. Some people believe that advances in oilfield technology, such as extended-reach drilling and smaller areas required for production pads, have greatly reduced the industry's impact on the environment. Some point to the importance of finding and developing new oilfields for the Nation's future energy supply and the State's and NSB's financial health in the face of declining oil production in the Prudhoe Bay and Kuparuk River fields. Others oppose development, arguing that the NPR-A should be treated as an energy savings account to be tapped only when needed under a national energy policy, and that the area's remote, scenic, and primitive values outweigh the transitory benefits of development. The lack of a comprehensive environmental analysis and land use plan for the entire North Slope also was highlighted by many people as a critical issue, citing the cumulative effects of past, present, and future land use activities, particularly on- and offshore petroleum development, on various resources and their uses. Specific issues involving oil and gas development and surface values in the planning area are highlighted in the statements below.
- **Resources of the Teshekpuk Lake Special Area.** The Teshekpuk Lake Special Area is important to North Slope residents for subsistence hunting and fishing and is recognized worldwide for its significance during critical life stages of waterbirds and the Teshekpuk Lake Caribou Herd. This area also includes some of the lands under study considered to have the highest potential for oil and gas resources. Surface resources could be impacted by oil and gas development, as well as other potential land use activities in the northeast planning area.
- **Resources of the Colville River Special Area.** The Colville River Special Area provides important habitat for raptors, moose, neotropical migratory birds, and fish. In addition, it contains world-class paleontological deposits and is an important corridor for subsistence and recreational activities. These resources could be impacted by oil and gas development and other potential land uses.
- **Subsistence Resources and Their Traditional Uses by North Slope Residents.** Many North Slope residents recognize the potential benefit of oil and gas development in the form of tax revenue, employment opportunities for individuals and local businesses, and a new and cheaper fuel source. Nevertheless, they have major concerns about the continuation of their traditional subsistence lifestyle in the face of change. Oil and gas leasing and other land use activities, such as increased recreational activities, could affect local communities in complex interrelated ways through environmental, cultural, social, and economic changes.
- **Environmental Quality.** Concerns regarding environmental quality ranged from air- and water-quality issues to oil-spill prevention and response. The public is concerned about the effects of oil spills, drilling fluids, and other contaminants on fish, wildlife, and air and water quality.

SECTION II

ALTERNATIVES

II. ALTERNATIVES

A. INTRODUCTION: This section presents BLM's alternative management approaches for 4.6 million acres in the northeastern part of the National Petroleum Reserve-Alaska (NPR-A). These alternatives are organized to present a range of actions that BLM could take to manage the surface and subsurface resources of the planning area.

Before considering the various management strategies put forward for consideration in these alternatives, readers should be aware that some management actions will occur under all alternatives. These include fulfilling BLM's responsibility to convey land to individual Alaskan Natives and to Native corporations under the Native Allotment Act and the Alaska Native Claims Settlement Act (ANCSA), respectively. In cooperation with other Federal, State, and North Slope Borough (NSB) resource management agencies, BLM also will inventory and monitor resource populations and conditions under all alternatives. Inventory and monitoring will assess the health of biological resources, the location and significance of other resources, and the effectiveness of management practices in protecting these resources. The scope of inventory and monitoring will reflect the level of impacting actions allowed and the protective measures imposed under the plan adopted through this Integrated Activity Plan/Environmental Impact Statement (IAP/EIS). For a general description of the anticipated inventory and monitoring program, see Appendix A.

B. LAND USE EMPHASIS AREAS (LUEA'S): Each alternative contains management actions for the entire planning area. Certain parts of the area, however, are particularly important because of their surface resource values. These areas are called Land Use Emphasis Areas, and much of the discussion of the alternatives is organized to show what management is proposed in each alternative for each LUEA. Nearly all LUEA's identify specific resource values, such as important bird or caribou habitat, that are linked to specific pieces of land. In this way, BLM will be able to focus specific management measures for each resource on the appropriate lands. Some alternatives propose special designations for some LUEA's, and nearly all LUEA's have stipulations identified to protect specific resources within them.

While LUEA's provide much of the structure of the presentation of the alternatives, they are not in themselves administrative or legislative designations, and they carry with them no new regulatory authority. They are simply tools that BLM is using to identify geographic areas where it is considering management emphases to meet its responsibilities under existing authorities.

The primary existing authority for managing NPR-A rests on the National Petroleum Reserve Production Act (NPRPA). Under the Act, the Secretary of the Interior has very broad authority. His authority to protect surface resources is especially high in "Special Areas" designated by the Secretary. Special Areas are those areas within the NPR-A containing "significant subsistence, recreational, fish and wildlife, historical, or scenic value." Federal regulations (43 CFR 2361.1(c)) provide for the Secretary to undertake maximum protective measures for Special Areas consistent with the purposes of the NPRPA. Parts of two Special Areas are in the planning area: the Teshekpuk Lake Special Area (TLSA) and the Colville River Special Area (CRSA). Both encompass large geographic areas and are important to a variety of resources. See Sec. III.B.1 for a more detailed description of these Special Areas. All the LUEA's are entirely or partly in the TLSA or the CRSA.

Each LUEA is described below and depicted on an accompanying map. Figure IV.D.1 highlights some of the management proposed for each LUEA.

1. Teshekpuk Lake Watershed: The LUEA's boundary coincides with that of the TLSA within the planning area, although the latter's boundary extends to the west beyond the planning area. (Fig. II.B.1). This LUEA is one of the most productive, diverse, and unique wetland ecosystems on the North Slope. Teshekpuk Lake's range of habitat types includes a 20-foot (ft) deep basin and a complex shoreline that features bays, spits, lagoons, islands, beaches, and extensive shoal areas. The waterflow patterns in this extraordinarily flat landscape are complex, and the outlets and inlets can reverse flow, depending on lake levels and stream flows. The Miguakiak River reversed its flow in 1977, so that discharge from breakup flooding on the Ikpikpuk River flowed into Teshekpuk Lake. There also are numerous deep lakes, some as deep as 50 ft, around Teshekpuk Lake that provide overwintering habitat for fish. Numerous small streams within the watershed provide riverine habitat for aquatic and migratory animals.

2. Goose Molting Habitat: This LUEA is wholly encompassed by the TLSA (Fig. II.B.2). The lakes to the north and east of Teshekpuk Lake are the most significant habitat for brant and Canada geese on the North Slope of Alaska. Up to 23 percent of the Pacific flyway population of brant molt in this area (33,000 were counted one year). Up to 27,000 Canada geese have been counted. Up to 28,000 molting greater white-fronted geese and snow geese also use the area. Molting geese, which are highly sensitive to human disturbance, are present in the area from late June to mid- to-late August.

3. Spectacled Eider Nesting Concentrations: This LUEA is wholly encompassed by the TLSA (Fig. II.B.3). The North Slope is home to an estimated 6,500 spectacled eiders, which is by far the largest breeding population in North America. About 16 percent of the North Slope population nests within the planning area, mostly to the north and west of Teshekpuk Lake. The spectacled eider is listed as threatened under the Endangered Species Act.

Since the planning process began, the Steller's eider has been listed as threatened. Steller's eiders are known to nest in the planning area, but densities are too low to estimate concentration areas. For this reason, we have not developed a LUEA for the Steller's eider.

4. Teshekpuk Lake Caribou Habitat: This LUEA is wholly encompassed by the TLSA (Fig. II.B.4). Caribou of the Teshekpuk Lake Herd calve from late May to mid-June. Since 1976, studies show that the main areas for calving can shift somewhat within the broad area identified on Fig. III.B.5.a-1, with concentrations occurring in several different locations around the lake from year to year. For the remainder of the summer, areas of shorelines, barren dunes, and ridges can provide relief from intense insect harassment, which can significantly affect energy budgets and future productivity of cows. The land between Teshekpuk Lake and the Beaufort Sea from the Ikpikpuk River to the Kogru River are particularly valuable for this purpose.

5. Fish Habitat: This LUEA contains numerous waterbodies that provide important spawning, migration, rearing, and overwintering habitat for both anadromous and resident species of fish (Fig. II.B.5). Fish use includes a substantial subsistence harvest by the residents of Barrow and Nuiqsut and a commercial take at the mouth of the Colville River. The LUEA extends ½ mile (mi) on the east side of the Ikpikpuk River, both sides of the Miguakiak River, the west side of the Colville River, and around Teshekpuk Lake (where BLM manages the land). It extends ¼ mi from both sides of Fish and Judy creeks and around the perimeter of any fish-bearing lake in the deep-lake zone identified on Fig. II.B.5. The Miguakiak River, Teshekpuk Lake, and the northern part of the Ikpikpuk River are within the TLSA. The west side of the Colville River is within the CRSA.

6. Colville River Raptor, Passerine, and Moose Area: The boundary of the LUEA extends from the eastern boundary of the planning area to 1 mi west of the bluffs of the Colville River from approximately Ocean Point to the southern end of the planning area and 1 mi either side of bluffs on the Kogosukruk and Kikiakrorak rivers (Fig. II.B.6). The part of this LUEA on the Colville is within the northern portion of the CRSA as are the very northern reaches of the Kogosukruk and Kikiakrorak rivers. The lower two-thirds of the Colville River supports the highest concentrations of raptors, passerines, and moose on Alaska's North Slope. More than half of the known peregrine, gyrfalcon, and rough-legged hawk territories along this reach are in the planning area. Overall, the population of peregrine falcons has increased since its low in 1973 at the time it was listed as endangered under the Endangered Species Act (ESA). It is now delisted. Current population levels should be maintained, if the peregrine is to remain off the list. The raptors nest on bluffs adjacent to the river and are sensitive to disturbance. The moose and passerine bird habitats along the Colville River represent a mixed ownership of Federal, State, and Arctic Slope Regional Corporation lands. The BLM will propose and work toward developing with the other landowners a cooperative agreement to include the area in an International Neotropical Migratory Bird Conservation Program Bird Conservation Area under the Partners in Flight program (Fig. II.B.7). While this designation carries no mandated restrictions, it will highlight for all three land managers a habitat with special values.

7. Umiat Recreation Site: This LUEA consists of a small tract of BLM land adjacent to Umiat's airstrip (Fig. II.B.8). It is within the CRSA's boundaries. The airstrip and other nearby lands are owned by the State. The BLM land could be used to access the remains of previous oil-exploration activities in the area and views of the Colville River. Development of an airpark and interpretive trails would be a cooperative endeavor with the State of Alaska.

8. Scenic Areas: This LUEA is within the boundaries of the CRSA (Fig. II.B.9). The Scenic Areas LUEA is based on a scenic quality study completed as part of the report required by Section 105(c) of the NPRPA. The study identified two sections of the Colville River as having high scenic value. One section extends from the southern tip of the planning area to Umiat. It has a scenic class rating of A, which means that is has a great deal of visual variety, contrast, and harmony. The other section has a scenic class rating of B, meaning that is has a moderate amount of visual variety, contrast, and harmony. This section extends from Umiat to Sec. 10, T.8N., R.3E., Umiat Meridian. The LUEA extends at least 1,000 ft west of the eastern boundary of the planning area and in some cases can extend farther, where a larger viewshed exists.

9. Pik Dunes: The Pik Dunes LUEA overlaps the southern boundary to the TLSA (Fig. II.B.10). The dunes complex occupies roughly 15 square miles. Its maximum extent north/south is 5.5 mi, while its maximum east/west extent is 5.0 mi. The Pik Dunes, which form a basin containing five lakes, are part of a larger dune area that has been stabilized/vegetated for at least several thousand years. The Pik Dunes are unique in that they are still exposed and active. Beyond their geologic and scenic uniqueness, the dunes provide (1) insect-relief habitat for caribou, (2) habitat for several uncommon plant species, and (3) data critical to understanding major climatic fluctuations over the last 12,000 years. In addition, cultural remains dating from about 12,000 years ago have been found there.

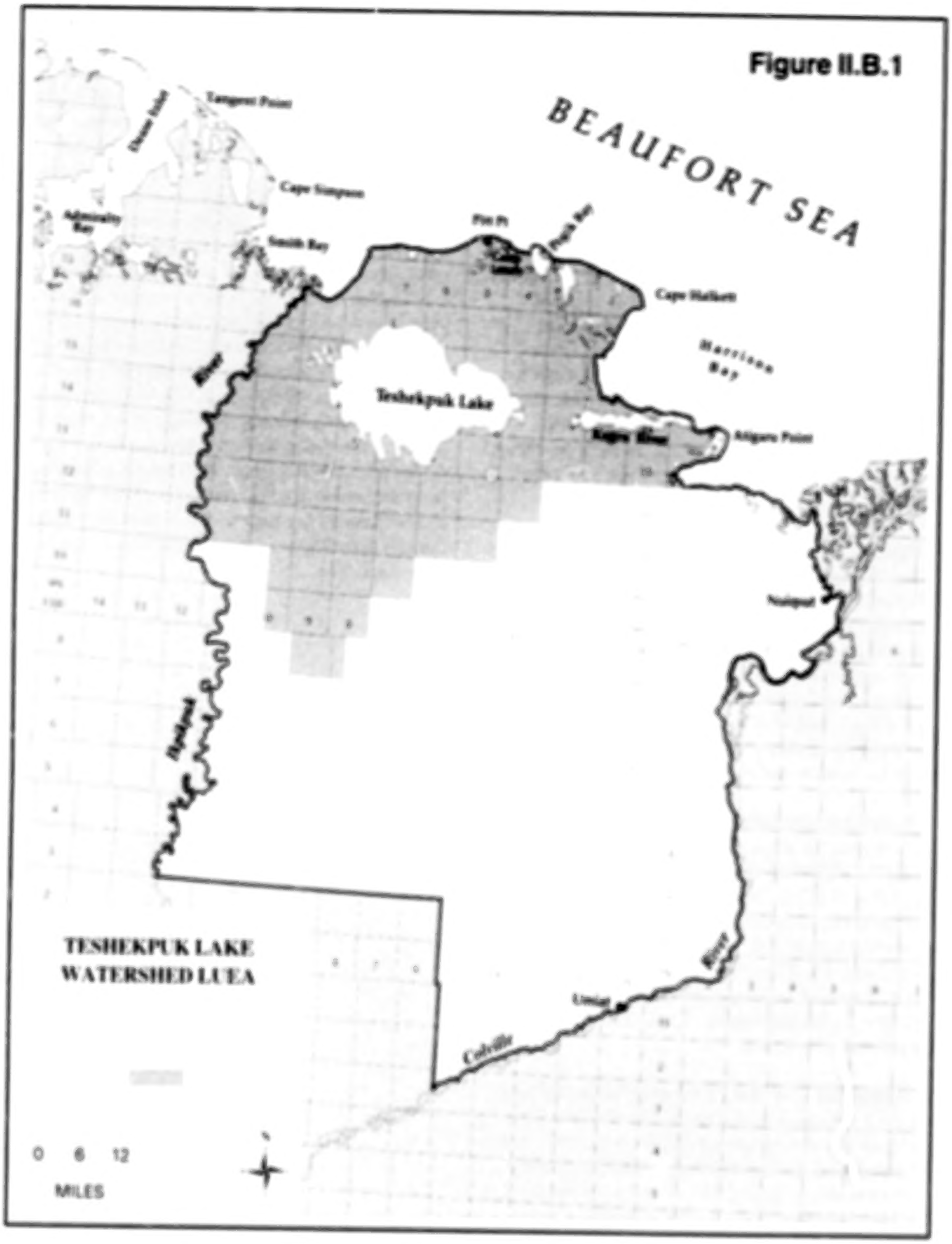
10. Ikpikpuk Paleontological Sites: The Ikpikpuk Paleontological Sites LUEA extends the entire river's length within the planning area (Fig. II.B.12). Its boundaries lie along section lines to the east of the river that are, on average, 1 mi from the river's edge. Its northern reach is within the western part of the TLSA. Along most of its length, the river cuts through mainly Quaternary age fossil-bearing formations, causing many specimens to be deposited on the shore or sandbanks. Most of the remains that erode out are illegally collected.

11. Kuukpik Corporation Entitlement: The lands in this LUEA are subject to conveyance to Kuukpik Corporation, the ANCSA corporation for the village of Nuiqsut (Fig. II.B.13). The corporation has approximately 13,000 acres remaining in its entitlement and it is in the process of making its final selections from the approximately 100,000 acres in this LUEA. Selected lands would be conveyed to private ownership and would be unavailable for Federal leasing. Some of the available lands are within the CRSA.

12. Potential Colville Wild and Scenic River: The LUEA includes a ½ mi strip on the west side of the Colville River from the southern planning boundary to Sec. 32, T.10N., R.5E. Umiat Meridian; within the planning area, the east side of the Colville as well as its bed are in either State or Native (ASRC) ownership (Fig. II.B.14). This LUEA is within the CRSA boundaries. Field studies indicate that the river has outstandingly remarkable values because of its importance to peregrine falcons and as a source for paleontological data. The river was nominated for inclusion in the Wild and Scenic River System (WSRS) in 1980, but no congressional action was taken. This issue is being revisited and BLM has determined that the river is *eligible* for inclusion in the WSRS.

The BLM will use this planning process to determine whether or not the river is *suitable* for inclusion in the WSRS and, if it is determined suitable, whether it should be managed as a wild, scenic, or recreational river. Appendix G outlines the criteria and issues that will be addressed to make the suitability determination. If the Colville River is determined to be suitable in the Record of Decision, the WSRA requires that the river corridor receive special protection. It will be managed, on an interim basis, in a way that is consistent with its tentative classification. Management actions and authorized uses will not be allowed to adversely affect this tentative classification. This management would be most restrictive under a tentative wild classification and least restrictive under a recreational classification. Appendix H describes the general management objectives and standards assigned to designated rivers and rivers under special protection. If BLM determines that the river is unsuitable for inclusion, it will be managed in a manner that is consistent with the Colville River Raptor, Passerine and Moose and Scenic Areas LUEA's.

Figure II.B.1



BEST COPY AVAILABLE

15

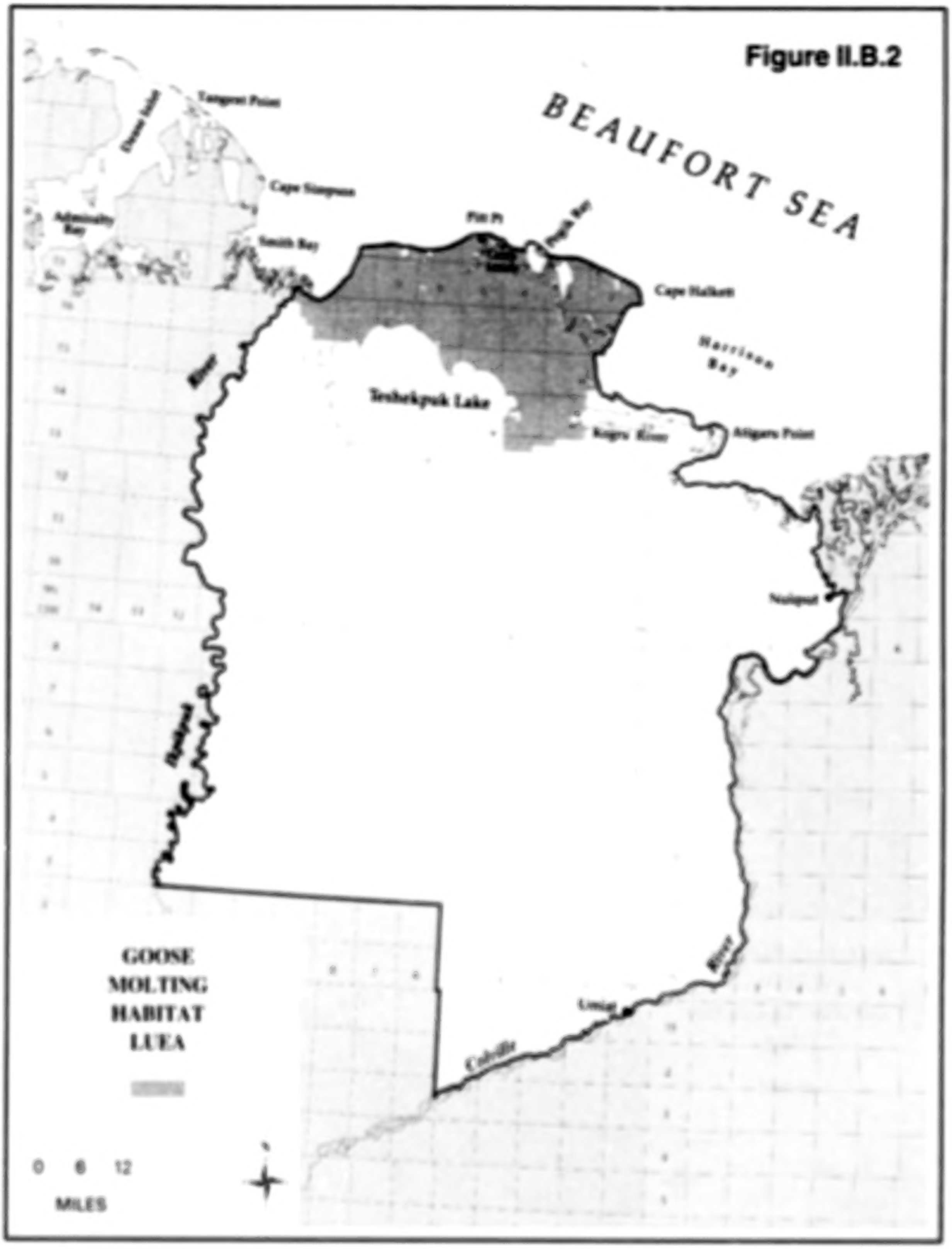


Figure II.B.2

BEST COPY AVAILABLE

16

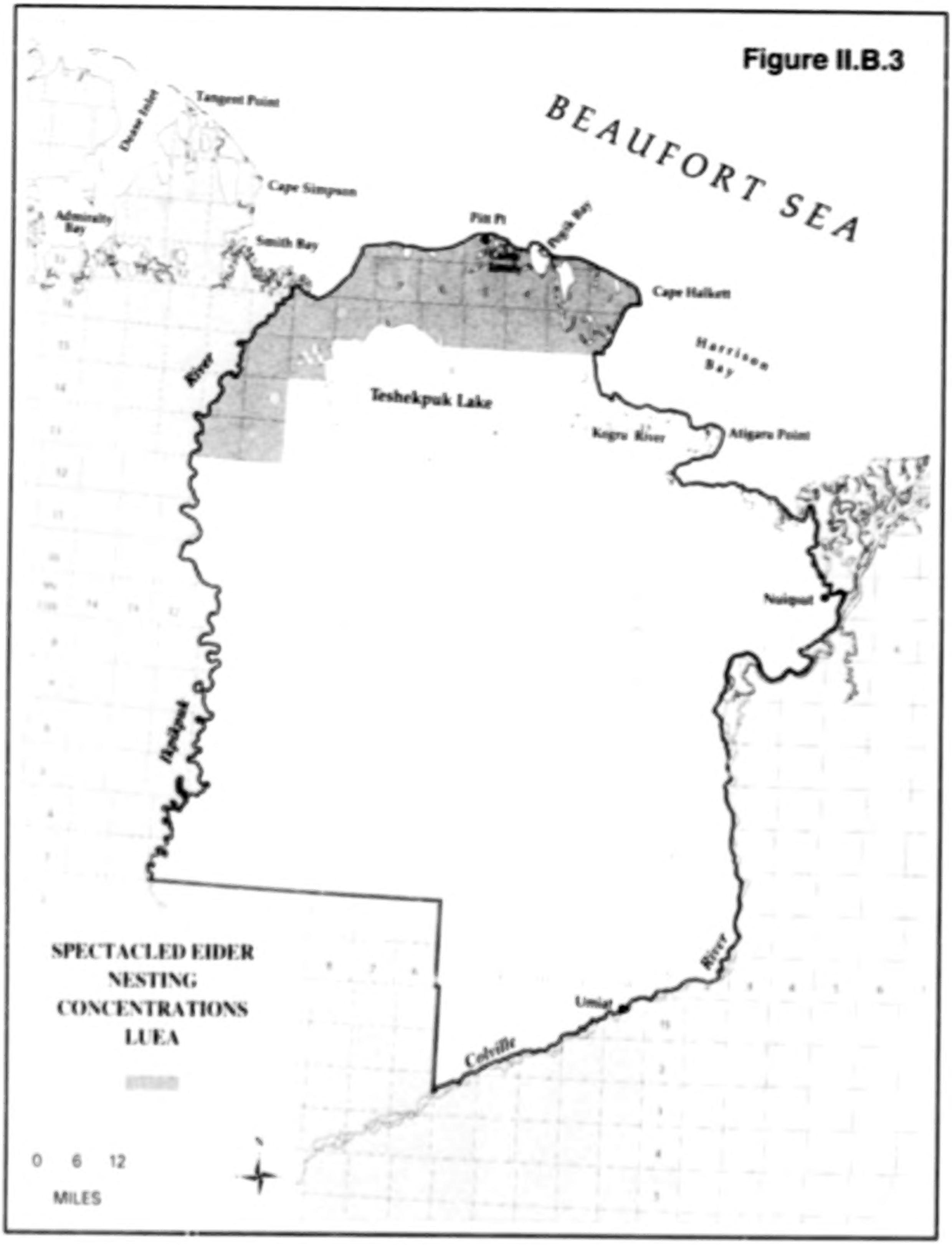


Figure II.B.3

BEST COPY AVAILABLE

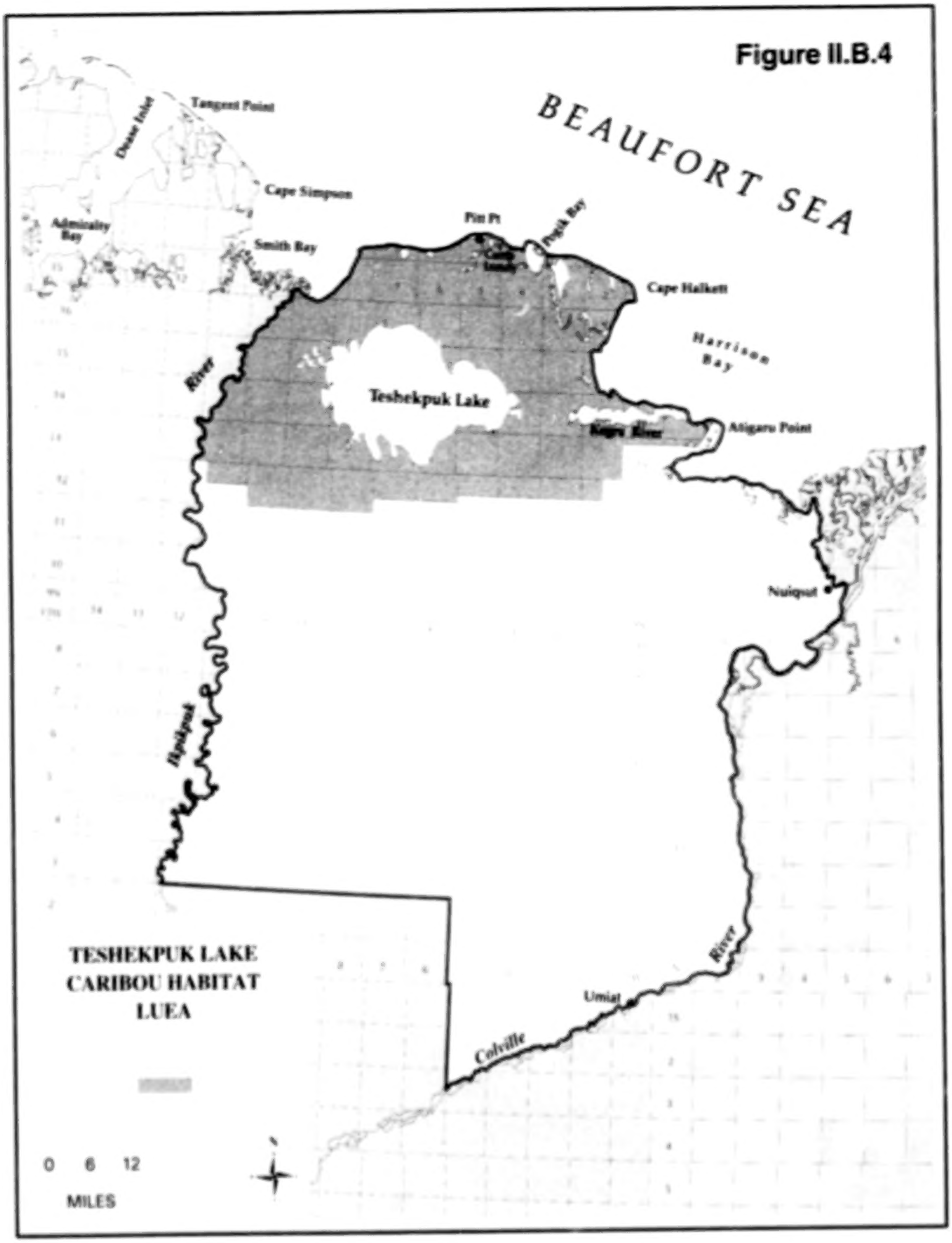


Figure II.B.4

BEST COPY AVAILABLE

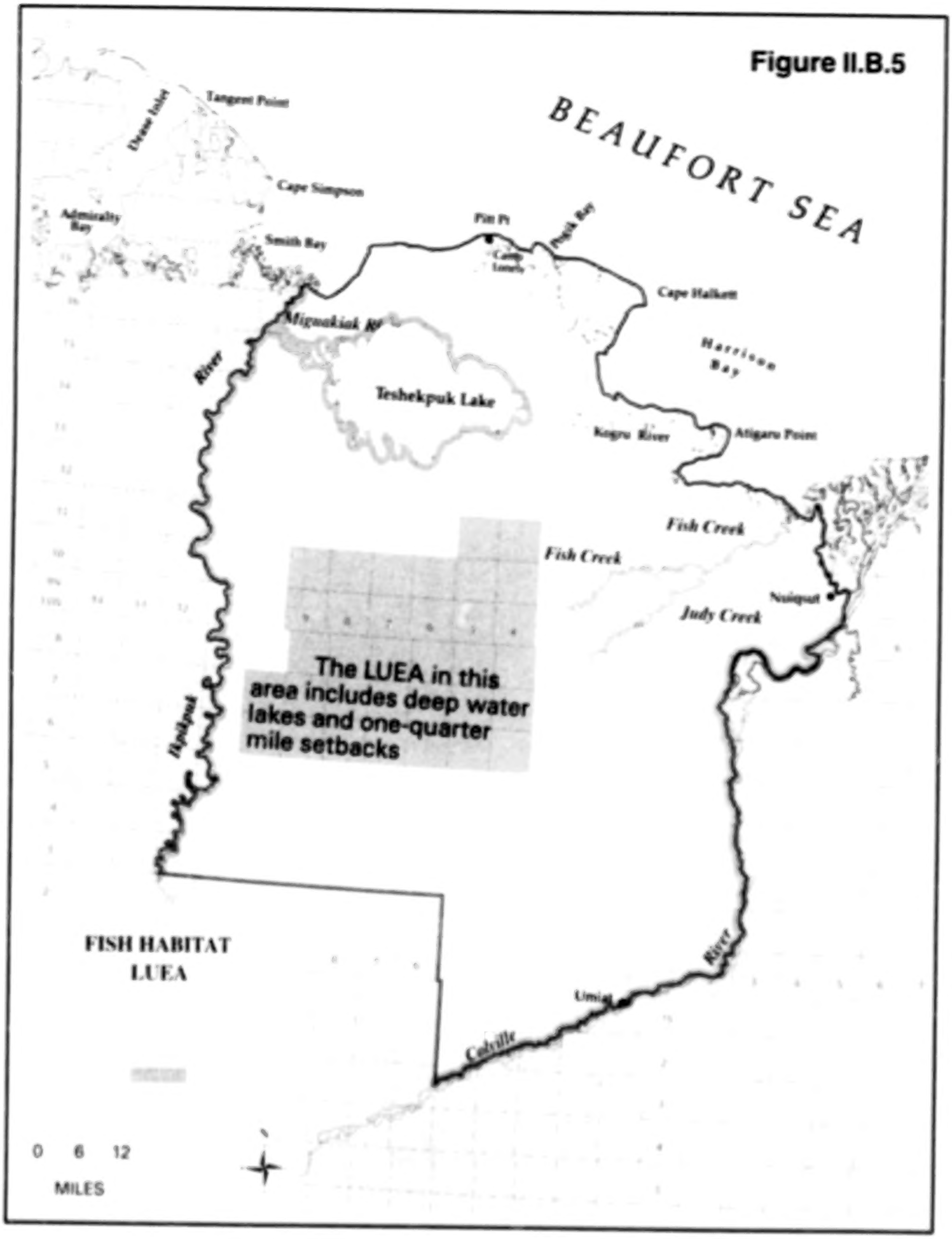


Figure II.B.5

The LUEA in this area includes deep water lakes and one-quarter mile setbacks

BEST COPY AVAILABLE

19

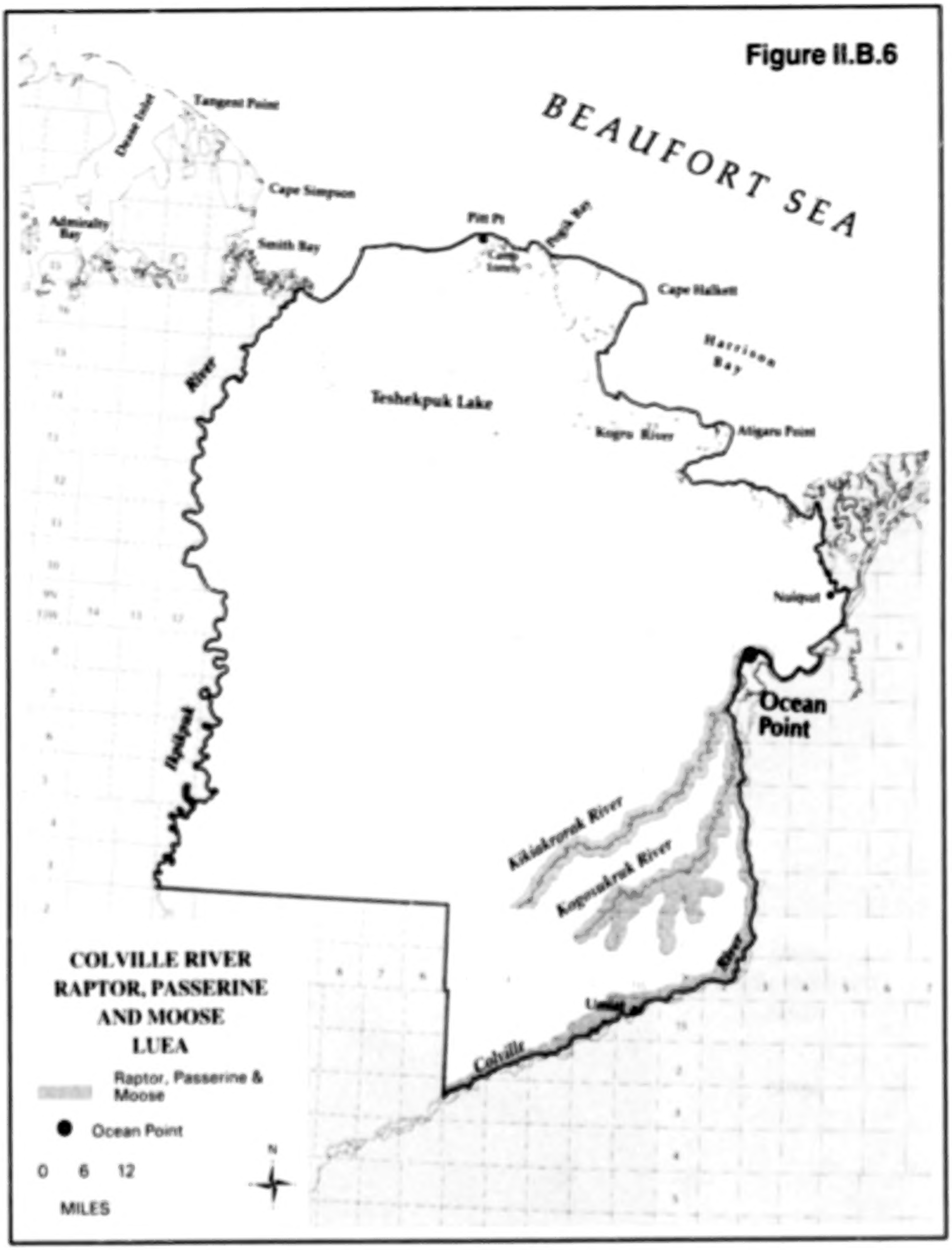


Figure II.B.6

BEST COPY AVAILABLE

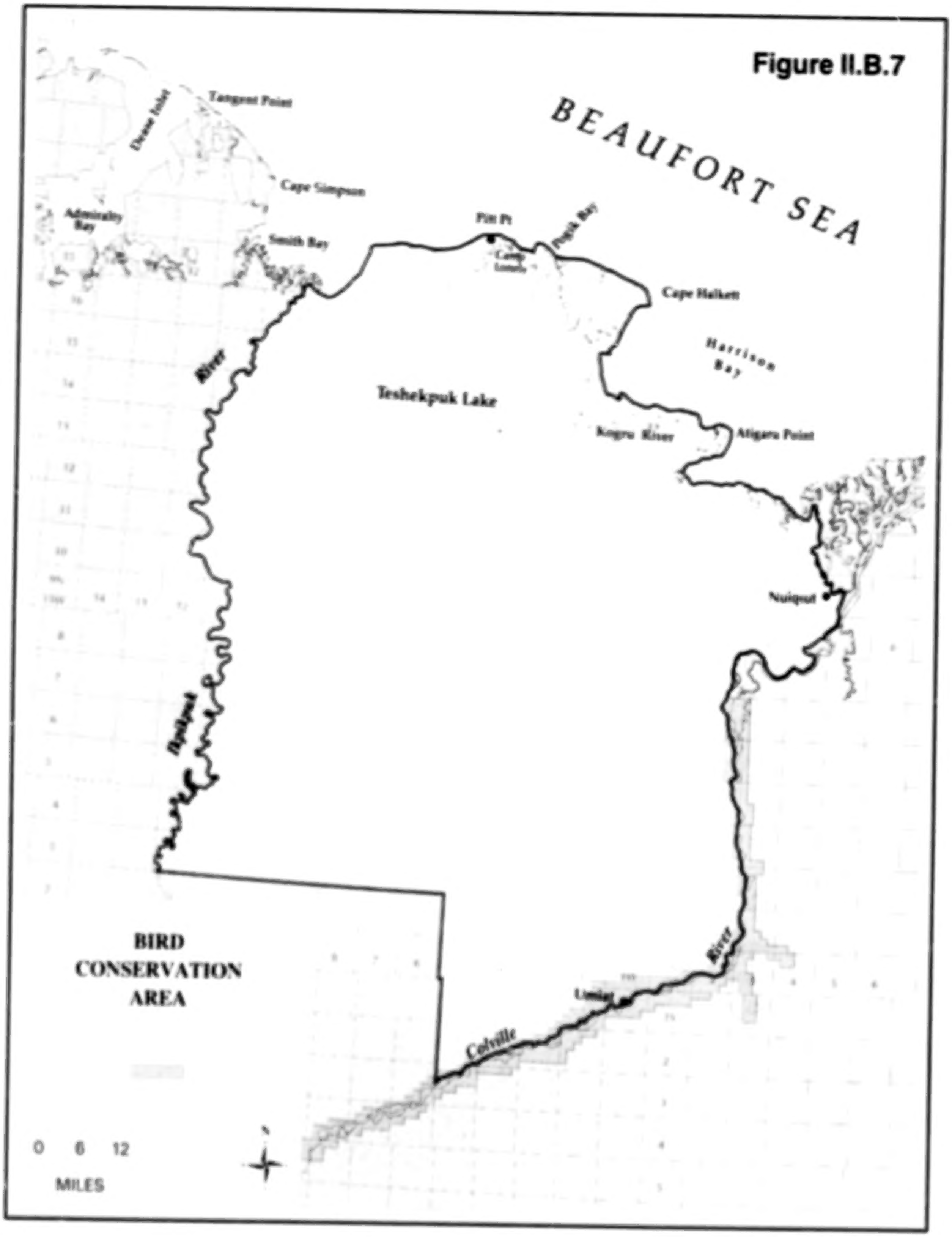


Figure II.B.7

BEST COPY AVAILABLE

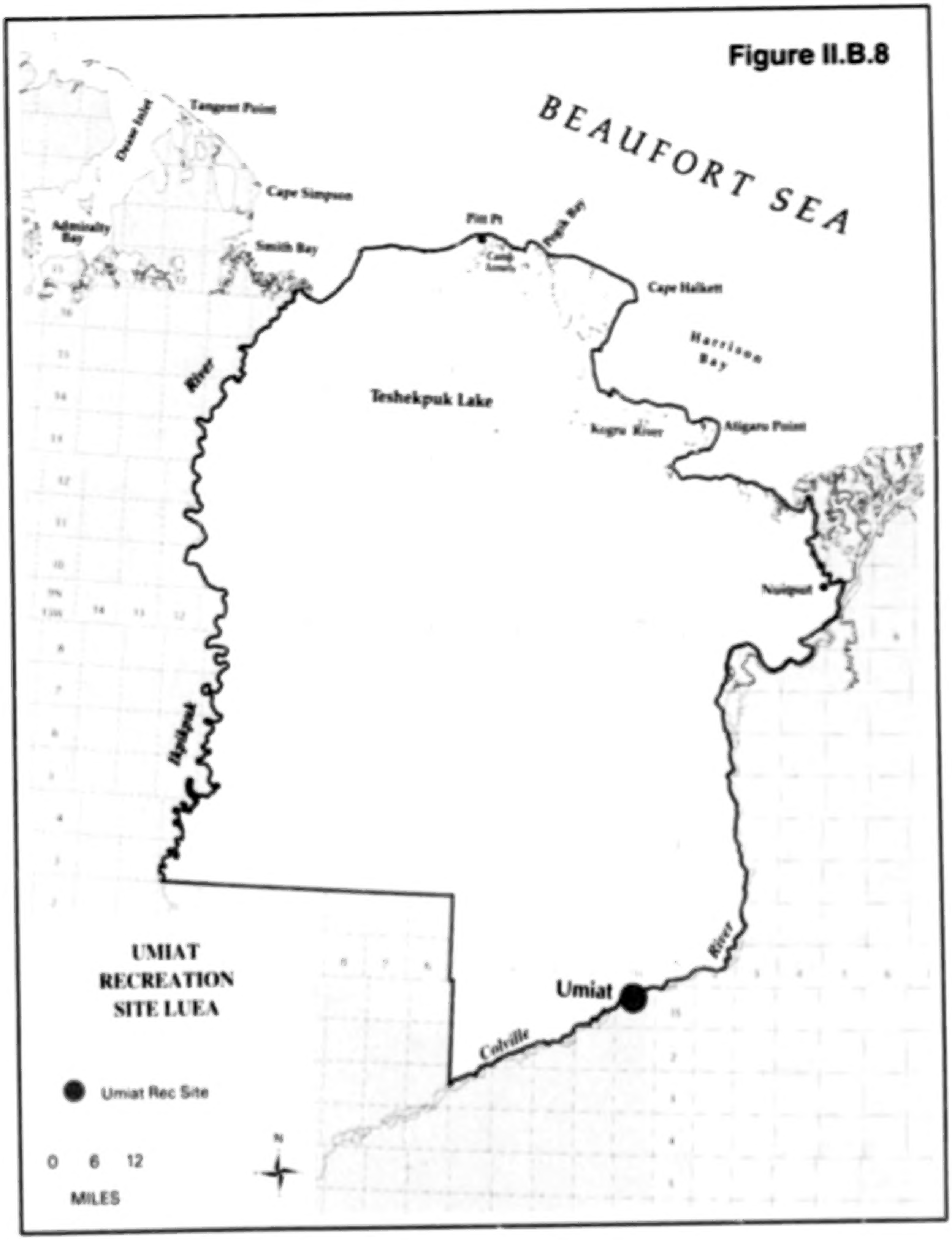


Figure II.B.8

BEST COPY AVAILABLE

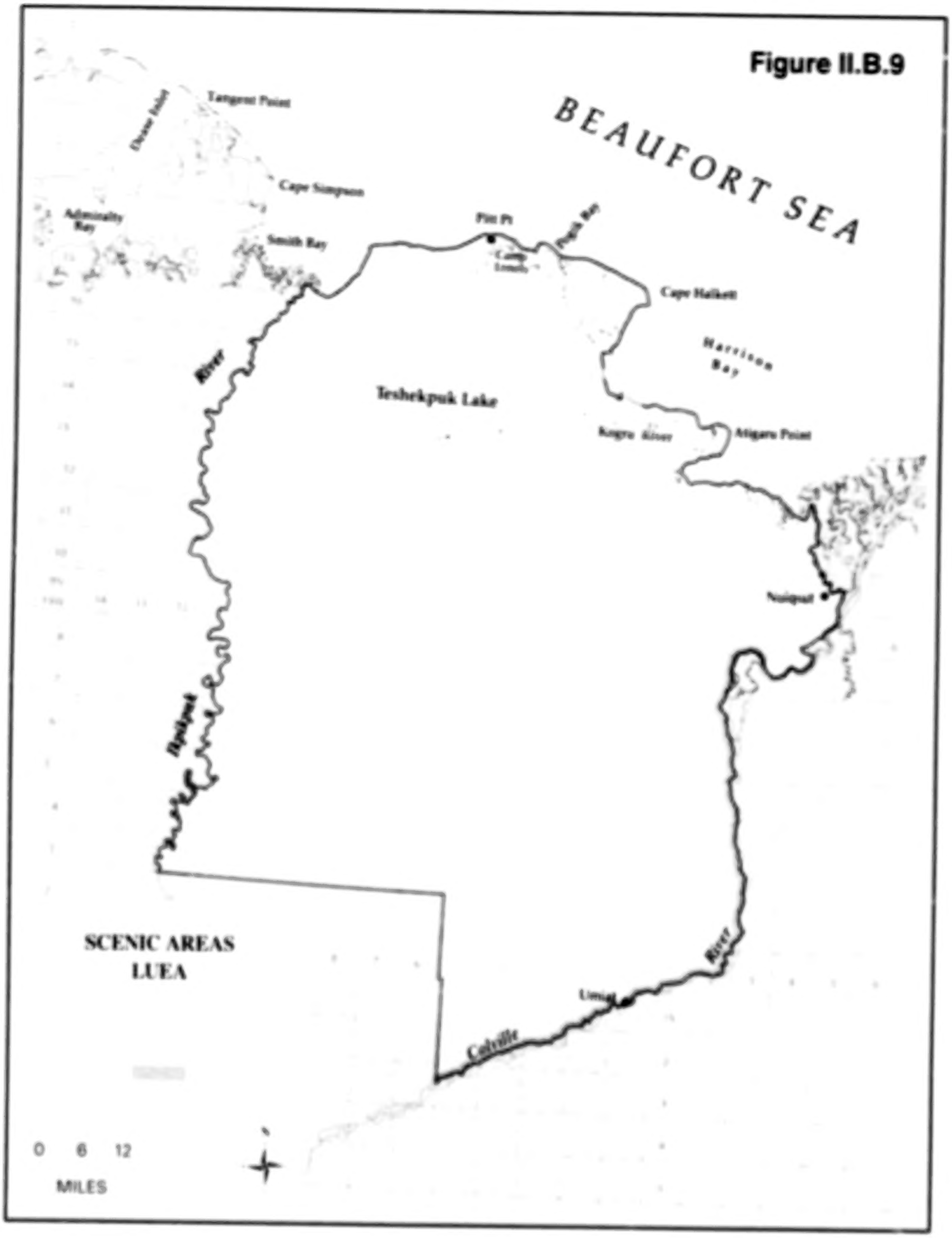
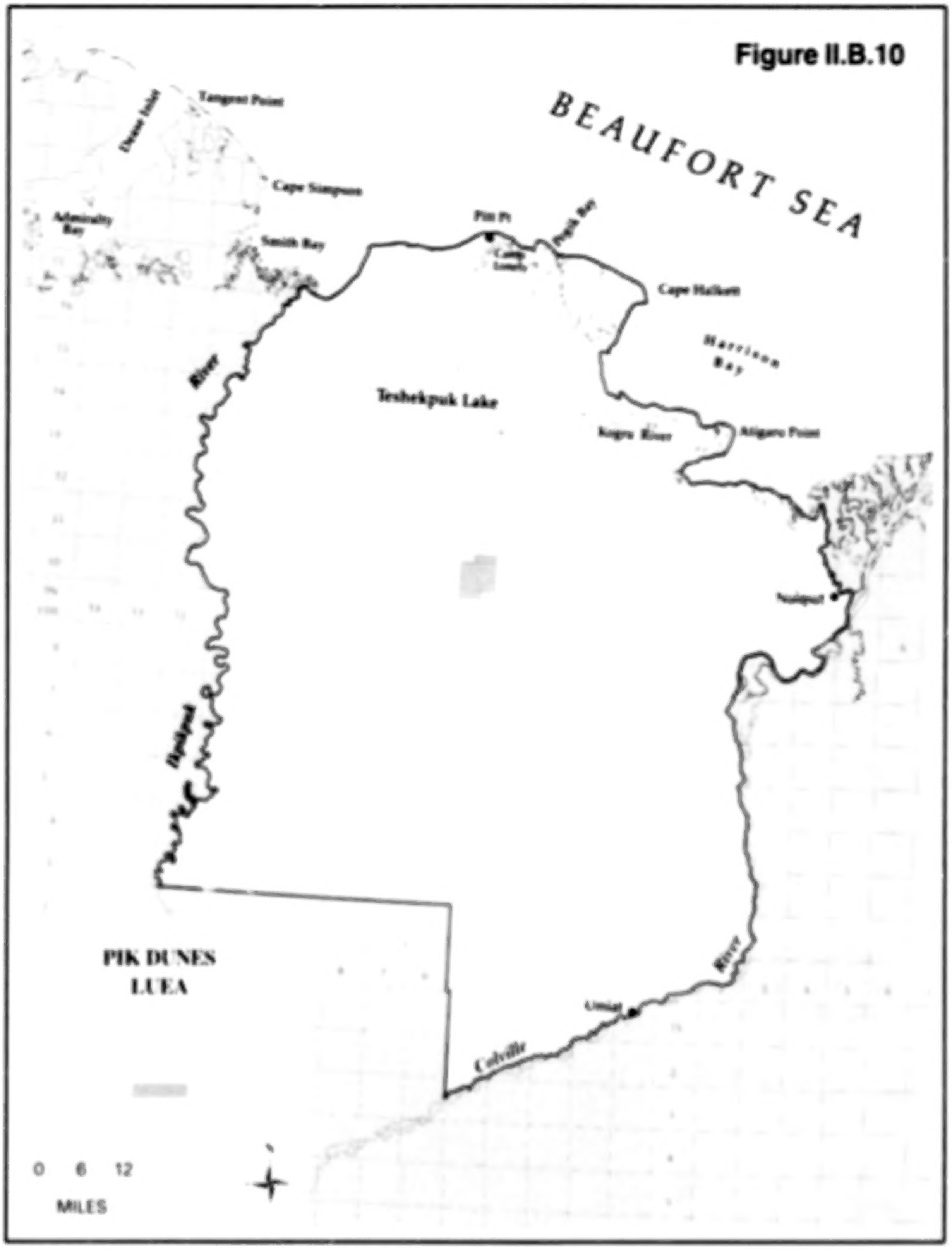


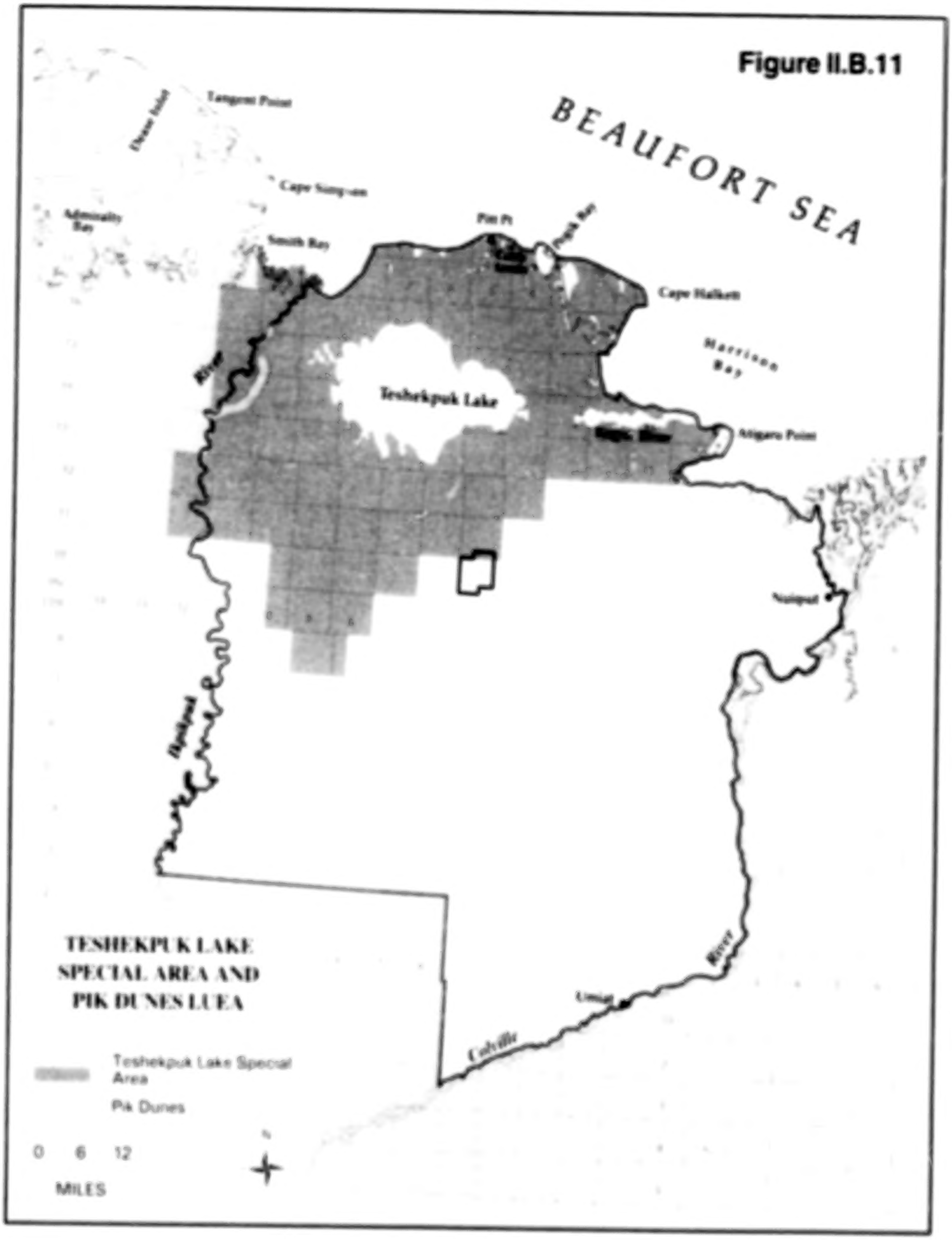
Figure II.B.9

BEST COPY AVAILABLE

Figure II.B.10



BEST COPY AVAILABLE



BEST COPY AVAILABLE

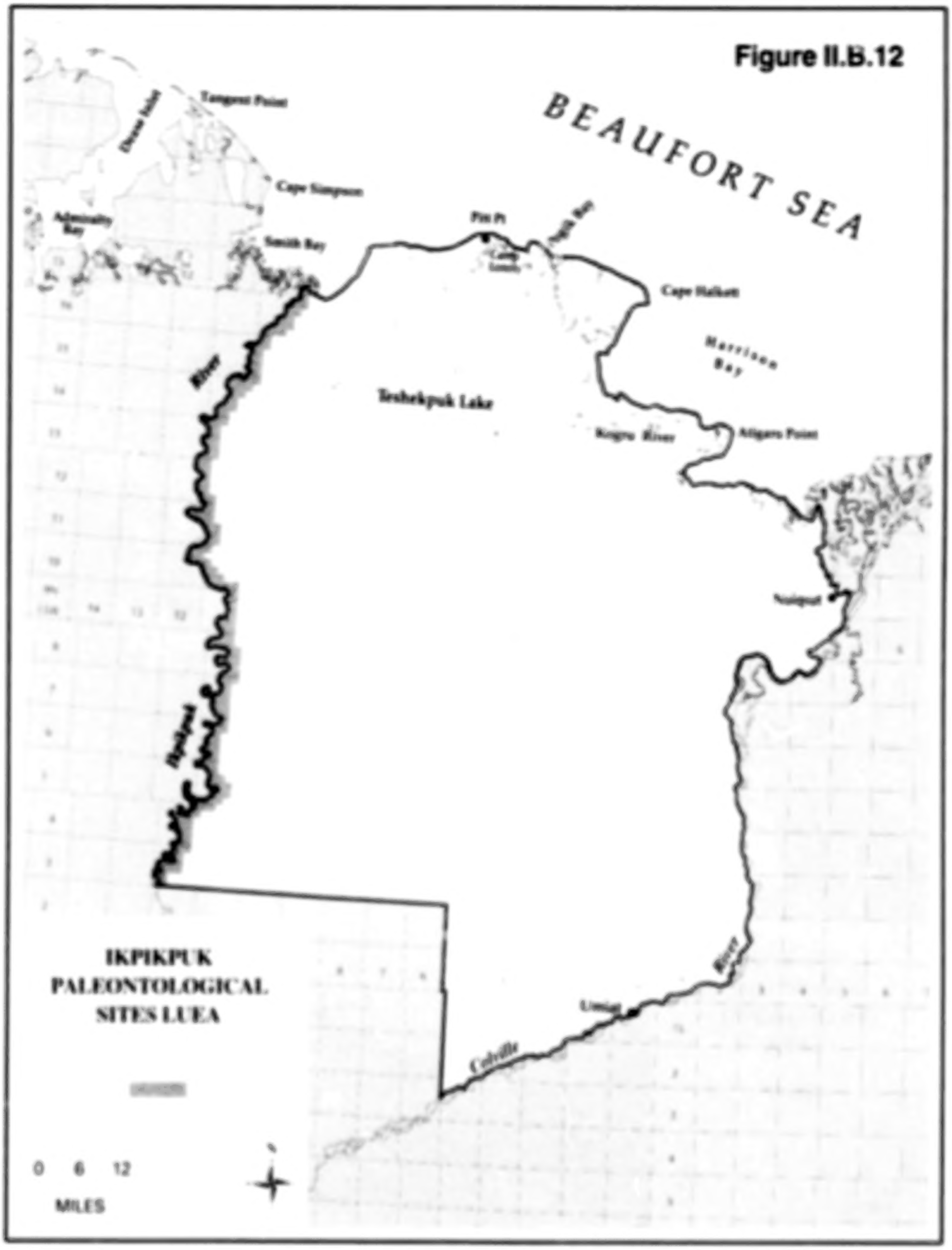


Figure II.B.12

IKPIKPUK
PALEONTOLOGICAL
SITES LUEA

BEST COPY AVAILABLE

26

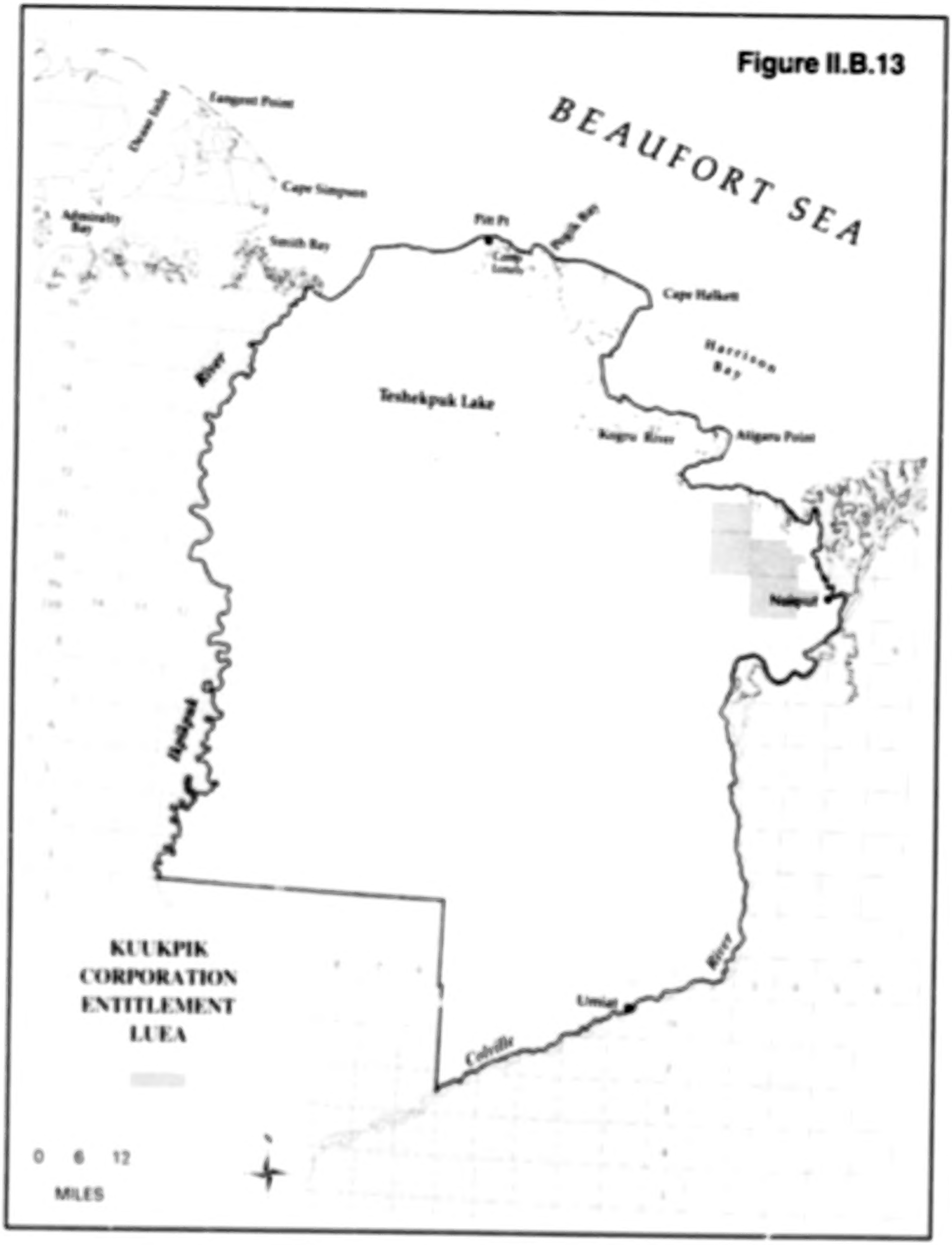


Figure II.B.13

BEST COPY AVAILABLE

27

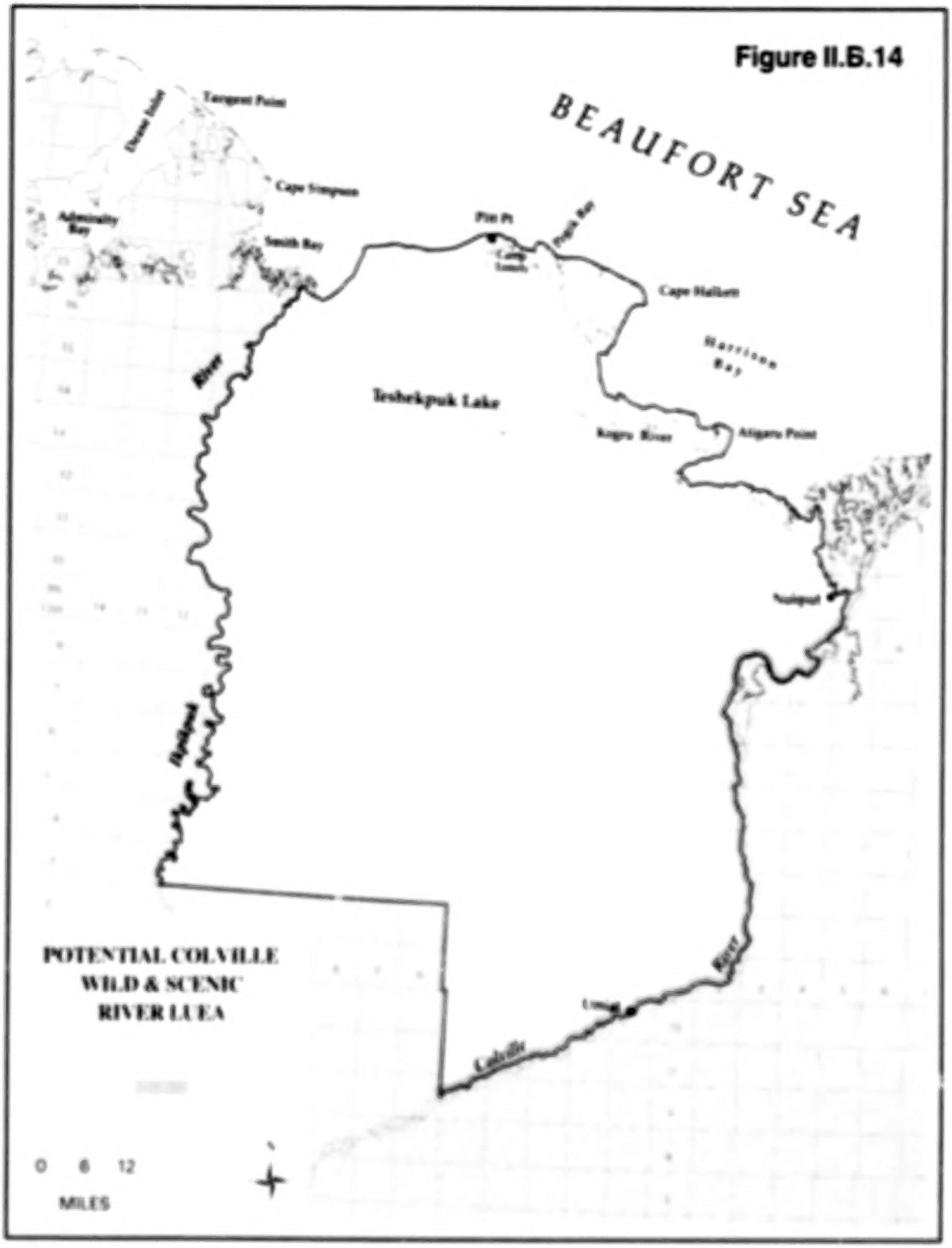


Figure II.B.14

BEST COPY AVAILABLE

28

C. ALTERNATIVES: The descriptions of the alternatives that follow provide a general picture of how BLM will manage its lands in the planning area. Getting a complete and detailed understanding of how the alternatives protect some resources while authorizing a variety of activities requires a close reading of the stipulations in Section II.C.7. These stipulations indicate where, when, and how certain activities may be restricted so that they can occur in the nonprohibited times and places.

1. Preferred Alternative or Proposed Action: There is no Preferred Alternative or Proposed Action. Rather, we have decided to present a set of alternatives for public review and comment and to select a Proposed Action after receiving comments from the public. This Proposed Action may be one of the alternatives presented here or it may be a new alternative combining parts of one or more of the alternatives in this Draft IAP EIS.

2. Alternative A: This alternative is the No Action alternative (Fig. II.C.1-1). It reflects current BLM management of the planning area and a decision BLM has made that the 1983 EIS for the last leasing program is inadequate for a new program. No oil and gas leases would occur, no new designations such as Special Areas or Wild and Scenic Rivers would be proposed, and protection of surface resources from other activities would be provided by those stipulations in Section II.C.7 that apply to all alternatives. Under this alternative two options exist with regard to seismic activity. Winter seismic activity could occur throughout the planning area (the existing management situation), or seismic activity could be prohibited.

3. Alternative B: Alternative B would make nearly half of the planning area (almost a quarter of the high oil and gas potential area) available for oil and gas leasing while emphasizing protection of specific surface resources. With the exception of the Kuukpik Corporation Entitlement LUEA, none of the LUEA's would be made available for oil and gas leasing (Fig. II.C.1-2). Leasing in the Kuukpik Corporation Entitlement LUEA would be postponed until the corporation's entitlement has been satisfied. Aboveground pipelines could cross all lands except the Potential Colville Wild and Scenic River LUEA, and all lands would be available for seismic studies. Protective measures include applying the relevant restrictions in Section II.C.7, recommending a portion of the Colville be included as a wild river in the WSRS, proposing a Bird Conservation Area along the Colville River, designating the Ikpikpuk Paleontological Sites LUEA as a new Special Area to protect paleontological resources, and adding the Pik Dunes LUEA to the Teshekpuk Lake Special Area. Upon Secretarial designation of the Ikpikpuk Paleontological Sites LUEA as a Special Area, BLM would develop a plan for the new Special Area to determine appropriate additional management measures, such as research studies and interpretive and educational actions to enhance understanding of the paleontology of the North Slope. Upon completion of an agreement with the State and ASRC to nominate a Bird Conservation Area, BLM would join with the other landowners in a study of this neotropical migratory bird habitat, the populations of these birds in the area, and the appropriate management desirable for protection of the animals and their habitat. Upon Congressional designation of the Colville River as part of the WSRS, BLM would conduct a River Management Plan jointly with the State and ASRC.

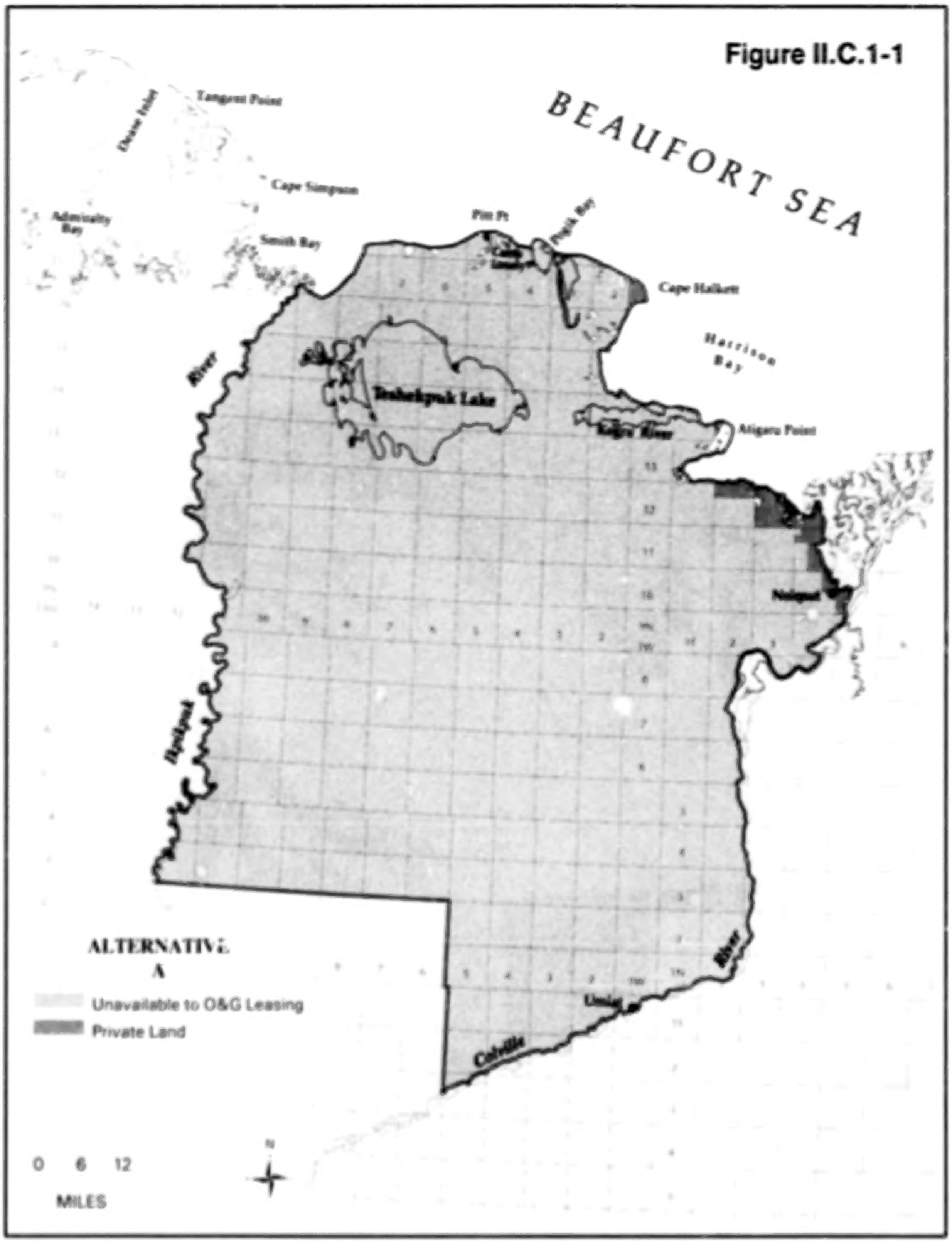
4. Alternative C: Alternative C would make nearly three-quarters of the planning area (more than a third of the high oil and gas potential area) available for oil and gas leasing (Fig. II.C.1-3). The Teshekpuk Lake Caribou Habitat LUEA and the Goose Molting Habitat LUEA, which contain important caribou and waterfowl habitat, would not be made available. The Kuukpik Corporation Entitlement LUEA would be available for oil and gas leasing, and royalties would be put in escrow. Aboveground pipelines could cross all lands, and all lands would be available for seismic studies. Protective measures include applying the relevant restrictions in Section II.C.7, recommending a portion of the Colville be included as a scenic river in the WSRS, proposing a Bird Conservation Area along the Colville River, designating the Ikpikpuk Paleontological Sites LUEA as a new Special Area to protect paleontological resources, and adding the Pik Dunes LUEA to the Teshekpuk Lake Special Area. Upon Secretarial designation of the Ikpikpuk Paleontological Sites LUEA as a Special Area, completion of an agreement with the State and ASRC to nominate a Bird Conservation Area, and/or Congressional designation of the Colville River as part of the WSRS, BLM would conduct the associated plans and studies as described for Alternative B.

5. Alternative D: Alternative D would make nearly 90 percent of the planning area (70% of the high oil and gas potential area) available for oil and gas leasing (Fig. II.C.1-4). The Goose Molting Habitat LUEA would not be made available. The Kuukpik Corporation Entitlement LUEA would be available for oil and gas leasing, and royalties would be put in escrow. Aboveground pipelines could cross all lands within the planning area, and all lands would be available for seismic studies. Important waterfowl habitat remains unavailable for oil and gas leasing. Certain stipulations in Section II.C.7 have been developed to protect caribou in the part of the Teshekpuk Lake Caribou Habitat LUEA available for oil and gas leasing. Other protective measures include applying other relevant stipulations in Section II.C.7, recommending a portion of the Colville be included as a recreational river in the

WSRS, proposing a Bird Conservation Area along the Colville River, designating the Ikpikpuk Paleontological Sites LUEA as a new Special Area to protect paleontological resources, and adding the Pik Dunes LUEA to the Teshekpuk Lake Special Area. Upon Secretarial designation of the Ikpikpuk Paleontological Sites LUEA as a Special Area, completion of an agreement with the State and ASRC to nominate a Bird Conservation Area, and or Congressional designation of the Colville River as part of the WSRS, BLM would conduct the associated studies and plans as described for Alternative B. In addition, the agency would conduct an interagency wildlife management plan focusing on caribou and waterbird populations within the Teshekpuk Lake Caribou Habitat and the Goose Molting LUEA's. This plan would guide inventory, monitoring, and behavioral studies both by Federal, State, and NSB agencies and, in the case of caribou, by oil and gas lessees.

6. Alternative E: Alternative E makes all BLM-administered lands in the planning area available to oil and gas leasing (Fig. II.C.1-5). The Kuukpik Corporation Entitlement LUEA would be available for oil and gas leasing, and royalties would be put in escrow. Aboveground pipelines could cross all lands within the planning area, and all lands would be available for seismic studies. Certain stipulations in Section II.C.7 have been developed especially to protect caribou in the Teshekpuk Lake Caribou Habitat LUEA and others protect waterfowl in the Goose Molting Habitat LUEA. Other protective measures include applying other relevant stipulations in Section II.C.7, proposing a Bird Conservation Area along the Colville River, designating the Ikpikpuk Paleontological Sites LUEA as a new Special Area to protect paleontological resources, and adding the Pik Dunes LUEA to the Teshekpuk Lake Special Area. The BLM would conduct the plans and studies of the Ikpikpuk Paleontological Sites LUEA, the Bird Conservation Area, and the caribou and waterbirds of the Teshekpuk Lake Caribou Habitat and the Goose Molting LUEA's and would conduct them under the same circumstances and for the same purposes as in Alternative D.

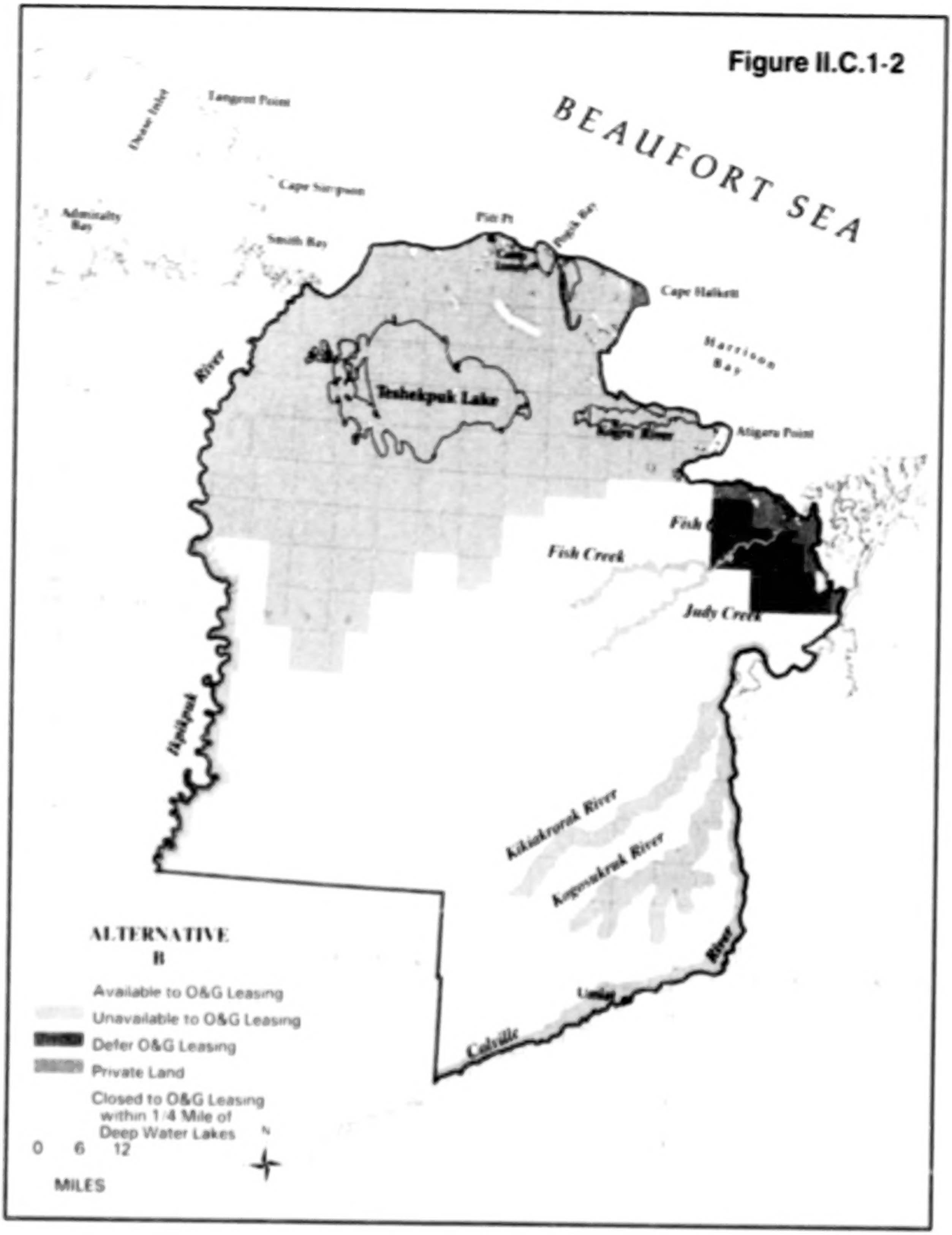
Figure II.C.1-1



BEST COPY AVAILABLE

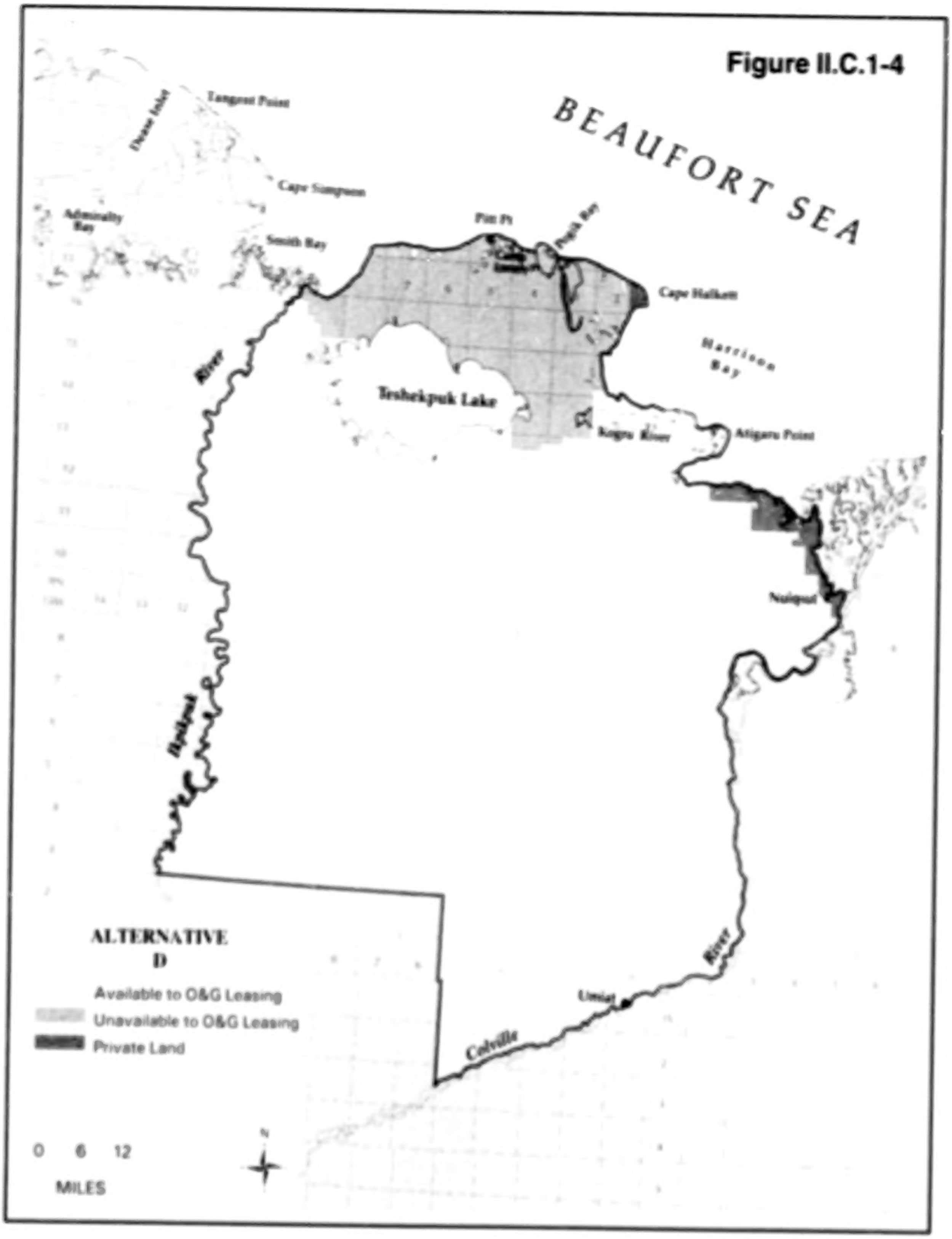
32

Figure II.C.1-2



BEST COPY AVAILABLE

Figure II.C.1-4



BEST COPY AVAILABLE

7. Stipulations: The following stipulations are part of the alternatives discussed above. They are based on existing policies and laws, and on knowledge of the resources present in the study area and current industry practices. The stipulations could evolve over time. Future changes to the stipulations would be preceded by the appropriate level of National Environmental Policy Act (NEPA) analysis. Those stipulations without brackets at their ends attach to all alternatives. Others apply only to the alternatives that are indicated in brackets. Those marked with an asterisk (*) would be incorporated as conditions of oil and gas lease sales for applicable lease tracts; those without an asterisk would be attached to applicable individual permits. If the BLM determines that additional stipulations are necessary during further NEPA analysis for any oil and gas activities (e.g., drilling) beyond the leasing program proposed by some of the alternatives presented above, BLM will include them in the appropriate NEPA document.

The management restrictions listed in this appendix may be modified or waived for specific authorizations and leases by BLM's Authorized Officer (AO) in the following instances:

a. if, and to the extent, the management restrictions listed below state that they permit such modifications;
b. if the restriction is not applicable for the activity or area for which the authorization is sought, e.g., restrictions specific to oilfield development would not apply to Special Recreation Permits and restrictions applicable specifically to the Colville River area would not be applicable to authorizations for activities in other parts of the planning area;
c. if the proponent of an activity demonstrates to the satisfaction of the AO, in consultation with the appropriate Federal, State, and NSB agencies, that a modification or waiver is environmentally preferable;
d. under Alternative D, the AO, after consulting with the appropriate Federal, State, and NSB agencies, may modify the restriction(s) in or allow exception(s) to stipulations that apply only within the Teshekpuk Lake Caribou Habitat LUEA in the case of oil gas activities if the lessee can demonstrate that the restriction(s) would make production technically infeasible or economically prohibitive, and can demonstrate that the goals of the stipulation can be accomplished through alternative means;
e. under Alternative E, the AO, in consultation with representatives of the appropriate Federal, State, and NSB agencies, may modify the restriction(s) in or allow exception(s) to all stipulations that apply only within the Teshekpuk Lake Caribou Habitat LUEA or the Goose Molting Habitat LUEA in the case of oil and gas activities if the lessee can demonstrate that the restriction(s) would make production technically infeasible or economically prohibitive, and can demonstrate that the goals of the stipulation can be accomplished through alternative means.
f. An exception to the restriction in stipulation 48 can be made by the AO if it can be determined that no other realistic route is feasible and if a change would have minimal effect on subsistence users.

Exemptions from all restrictions are granted in emergencies involving human health and safety. Exceptions will not relieve the proponent from restrictions imposed by Federal, State, or NSB law or regulation. Additional site-specific stipulations may result from subsequent site- or authorization-specific environmental analysis.

Solid- and Liquid-Waste Handling, Hazardous-Material Disposal and Cleanup

1. All feasible precautions shall be taken to avoid attracting wildlife to food and garbage. Larger undertakings (those involving more than 15 persons) shall have a written procedure to ensure that the handling and disposal of putrescible waste shall be accomplished in a manner to prevent the attraction of wildlife.

2. All solids and sludges shall be incinerated or disposed of by injection in accordance with U.S. Environmental Protection Agency (USEPA), State of Alaska Department of Environmental Conservation (ADEC), and the Occupational Safety and Health Act (OSHA) regulations and procedures.

3. All solid wastes shall be removed from BLM lands to ADEC-approved waste-disposal facilities. Solid-waste combustibles may be incinerated. All noncombustible solid waste, including ash from incineration and fuel drums, shall be removed for approved disposal. There will be no burial of garbage or human wastes.

4. Areas of operation shall be left clean of all debris.

5. All battery, hydrocarbon, and hazardous-material spills, including spills of seawater used for oilfield waterflood, shall be cleaned up immediately and completely, and all contaminated or treated products removed in accordance with USEPA, ADEC, and OSHA regulations and procedures.

6. As soon as possible, but not later than 24 hours after any discharge as defined in Alaska Statute Title 18, Chapter 75, Article 2, notice of such discharge shall be given to the AO and any other Federal and State officials as required by law.

7. For oil- and gas-related activities, a Hazardous-Materials Emergency- Contingency Plan must be prepared and implemented prior to transportation,

storage, or use of fuel. Staff shall be instructed in the procedures to follow. The plan should include a set of procedures to ensure prompt response, notification, and cleanup should hazardous substances be spilled or if there is a threat of a release. This plan should include a list of resources available for response (e.g., heavy-equipment operators, spill- cleanup materials or companies), and names and phone numbers of Federal, State, and NSB contacts.

8. Oil-spill-cleanup materials (absorbents, containment devices, etc.) shall be stored at all fueling points and vehicle-maintenance areas and be carried by field crews of all overland moves, seismic work trains, and similar overland moves by heavy equipment.

9. Fuel, other petroleum products, and/or other liquid chemicals designated by the AO, whether in excess of 660 gallons in a single tank or in excess of 1,320 gallons in multiple containers, shall be stored within an impermeable lined and diked area capable of containing 110 percent of the stored volume. The storage area shall be located at least 500 feet from any river, lake, or stream with the exception of small caches for motor boats and float planes. Material used as a liner must be capable of remaining impermeable during typical weather extremes expected throughout the storage period.

10. All fuel containers, including barrels and propane tanks, shall be marked with the responsible party's name, product type, and year filled or purchased.

11. Although fuels may be offloaded from aircraft on ice, there shall be no storage of fuels on lake or river ice or on active floodplains of any river or lake.

12. No refueling of equipment shall occur within 500 feet of the water's edge of any lake or stream, with the exception of refueling of motor boats, snowmachines, and float planes.

13. In order to prevent and minimize present and future pollution, management decisions affecting waste generation shall be considered in the following order of priority:
    -Waste source reduction
    -Recycling of waste
    -Waste treatment
    -Waste disposal

    a. Lessees are required to develop and obtain approval from the AO, in consultation with USEPA and ADEC, of a waste-management plan for all exploration, construction, and production operations (including activities conducted by contractors). The plan must identify all waste streams by type and volume that will be produced during each operation, as well as method of disposal. For each waste stream, the leases will describe what actions will be taken to minimize the volume.

    b. The preferred method for disposal of muds and cuttings from oil and gas activities is by injection. Injection of nonhazardous oilfield wastes generated during development is regulated by the Alaska Oil and Gas Conservation Commission, ADEC, and USEPA. Surface discharge of drilling muds and cuttings may be allowed into reserve pits only when the AO, in consultation with ADEC, determines that alternative disposal methods are not feasible and prudent. If use of a reserve pit is proposed, the operator must demonstrate the advantages of a reserve pit over other disposal methods and describe methods to be employed to reduce the disposed volume. On-pad temporary cuttings storage will be allowed as necessary to facilitate annular injection and/or back haul operations.

    c. Wastewater disposal:
        (1) Unless authorized by the National Pollution Discharge Elimination System (NPDES) or State permit, disposal of domestic wastewater into freshwater bodies, including wetlands, is prohibited.
        (2) Surface discharge of reserve-pit fluids will be prohibited unless authorized by NPDES, ADEC, and NSB permits and approval by the AO.
        (3) Disposal of produced waters in upland areas, including wetlands, will be by subsurface disposal techniques. The AO, in consultation with ADEC and USEPA, may permit alternate disposal methods if the lessee demonstrates that subsurface disposal is not feasible or prudent.
        (4) Discharge of produced waters into open or ice-covered marine waters of less than 10 meters in depth is prohibited. The AO in consultation with Alaska DEC may approve discharges into waters greater than 10 meters in depth based on a case-by-case review of environmental factors and consistency with the conditions of a NPDES permit.

Ice Roads and Water Use

14. The location of winter ice roads shall be offset from year to year to minimize vegetative impacts.

15. Compaction of snow cover or snow removal from fish-bearing waterbodies shall be prohibited except at approved ice-road crossings.

16. Water withdrawal will not be permitted from rivers and streams during winter. Water withdrawal shall be prohibited during winter from lakes less than 7 feet deep, if they are interconnected with or subject to seasonal flooding by a fish-bearing stream. Water may be withdrawn from isolated lakes that are less than 7 feet deep that lack connection to or are not subject to seasonal flooding by a fish-bearing stream. The AO may authorize withdrawals from any lakes less than 7 feet deep if the proponent demonstrates that no fish exist in the lake.

    Generally, water withdrawal drawdown during winter from lakes greater than 7 feet deep shall be limited to 15 percent of the estimated free-water volume (i.e., excluding the ice). The AO may authorize drawdown exceeding 15 percent from a lake greater than 7 feet deep if the proponent of the additional drawdown demonstrates that no fish exist in the lake.

17. Within the Goose Molting Habitat LUEA (Fig. II.B.2), water extraction from any lake used by molting geese shall not alter hydrological conditions that could adversely affect identified goose-feeding habitat along lakeshore margins.

18. Except for approved crossings, alteration of the banks of a waterway is prohibited. Clearing of willows along the riparian zone is prohibited.

Overland Moves and Seismic Work

19. Seismic work is not allowed within 1,200 feet of any cabin or known, long-term occupied campsite without written permission of the AO.

20. The following restrictions apply to overland moves, seismic work, and any similar use of heavy equipment (other than actual excavations as part of construction) on unroaded surfaces:
    a. Because polar bears are known to den predominantly within 25 miles of the coastline in the deeply drifted areas (6 feet or greater) adjacent to the high cut banks of drainages, seismic-program lines and overland moves should be aligned to avoid such areas by ¼ mile, if feasible. The cutting or compaction of such drifted snow is prohibited within 25 miles of the Beaufort Sea. Activities are prohibited within 1 mile of known or observed polar bear dens; obtain locations from U.S. Department of the Interior, Fish and Wildlife Service, (907) 786-3800. Operators are encouraged to apply for a letter of authorization from FWS to conduct activities in polar bear denning areas.
    b. Motorized ground-vehicle use will be minimized within the Colville Raptor, Passerine, and Moose Area LUEA from April 15 through August 5. Such use will remain ½ mile away from known raptor nesting sites, unless authorized by the AO.
    c. Travel up and down stream beds is prohibited to help avoid disturbance to riparian vegetation, stream-channel morphology, and resident fish populations.
    d. Crossing of waterway courses shall be made using a low-angle approach in order to not disrupt the natural stream or lake bank.
    e. If snow ramps or snow bridges are utilized at waterway crossings for bank protection, the ramps and bridges shall be substantially free of soil and/or debris. Snow bridges shall be removed or breached immediately after use or before spring breakup.
    f. To avoid additional freeze down of deepwater pools harboring overwintering fish, waterways shall be crossed at shallow riffles from point bar to point bar whenever possible.
    g. On-the-ground activities shall employ low-ground-pressure vehicles of the rolligon, ARDCO, Trackmaster, Nodwell, or similar type. A current list of approved vehicles can be obtained from the AO. Limited use of tractors equipped with wide tracks or "shoes" will be allowed to pull trailers.
    h. No bulldozing of tundra, trails, or seismic lines will be allowed. This stipulation, however, does not prohibit the clearing of drifted snow along a trail or seismic line nor in a camp, to the extent that the tundra mat is not disturbed. Snow may be cleared from a lake or river ice surface to prepare an aircraft runway, if approved by the AO in consultation with the State of Alaska, Department of Fish and Game (ADF&G).
    i. When multiple trips over the same trails are taken, vehicles will not utilize the same tracks, thereby reducing the possibility of ruts.
    j. Ground operations are to begin only after the seasonal frost in the tundra and underlying mineral soils has reached a depth of 12 inches, and the average snow cover is 6 inches deep.
    k. Ground operations will cease when the spring melt of snow begins; approximately May 5 in the foothills area where elevations exceed 300 feet, and approximately May 15 in the northern coastal areas. The exact date will be determined by the AO.
    l. No activity will occur within either the Goose Molting LUEA or the Teshekpuk Lake Caribou Habitat LUEA from May 1 through September 30 (Note that this overrides language in stipulation 20k.)
    m. To prevent surface disturbance to tundra and other vegetation, tracked vehicles will not execute tight turns by locking one track.

Oil and Gas Exploratory Drilling

21. From May 1 through September 30, exploratory drilling other than from production pads is prohibited in the Goose Molting Habitat LUEA and the Teshekpuk Lake Caribou Habitat LUEA. [Alts. D-E]

22. Oil and gas exploration activities will avoid alteration (e.g., damage or disturbance to soils, vegetation or surface hydrology) of critical goose- feeding habitat types along lakeshore margins (grass/sedge/moss), as identified by the AO in consultation with FWS, within the Goose Molting Habitat LUEA. [Alt. E]

23. Exploratory drilling is not allowed within 1,200 feet of any cabin or known, long-term occupied campsite without written permission of the BLM.

Facility Design and Construction

24. At least 3 years prior to approval of any development plan for leases within the Teshekpuk Lake Caribou Habitat LUEA the lessee shall design and implement a study of caribou movement within the LUEA. The study design will be approved by BLM in consultation with other Federal Agencies, the ADF&G, and NSB. The study will include a minimum of three years of data that will provide the data necessary to determine facility design and location, including pipelines, that will be part of the development plan. Lessees may submit individual plans or they may combine with other lessees in the LUEA to do a joint study. Total study funding by all lessees will not exceed $500,000.

25. Permanent oil and gas facilities (e.g., gravel roads, pads, airstrips, material sites), excluding pipelines, will not be permitted within a 1,640-foot buffer zone surrounding all goose-molting lakes, and within a 3,280-foot buffer zone around all high-use lakes within the Goose Molting Habitat LUEA. Goose-molting lakes will be identified by the AO in consultation with FWS. (Currently known lakes are identified in Appendix E, Fig. E-6.) [*]

26. To protect crucial caribou movement corridors for insect relief within 2 miles of the Beaufort Sea coastline including inlets and the Kogru River east of 152° 36'30" west longitude, the only oil and gas permanent surface occupancy permitted will be that determined necessary by the AO, because other locations are either technically infeasible or economically prohibitive. Examples of structures likely to be considered necessary under these criteria may include, but are not limited to: (1) a staging area, causeway, or dock that requires a year-round road to the inland area; (2) a seawater-treatment plant and associated pipeline or road; and (3) a production pad and associated pipeline for an oilfield that cannot be produced from outside the 2-mile zone. Airports, camps, and some types of processing facilities are not likely to be considered necessary. When submitting a development and production plan that includes structures in this 2-mile zone, the lessee shall demonstrate to the satisfaction of the AO, in consultation with the State and the NSB, the need for the location of permanent surface occupancy of structures within this zone. [Alts. D-E; *]

27. Causeways, docks, artificial gravel islands, and bottom-founded structures may be permitted if the AO, in consultation with the State and NSB, determines that a causeway or other structure is necessary for field development and that no feasible and prudent alternatives exist. A monitoring program may be required to address the objectives of water quality and free passage of fish, and mitigation shall be required where significant deviation from objectives occurs.

    The Bureau of Land Management discourages the use of continuous-fill causeways. Environmentally preferred alternatives for field development include use of buried pipelines, onshore directional drilling, or elevated structures. Approved causeways must be designed, sited, and constructed to prevent significant changes to nearshore oceanographic circulation patterns and water-quality characteristics (e.g., salinity, temperature, suspended sediments) that result in exceedances of water-quality criteria, and must maintain free passage of marine and anadromous fish.

    Causeways and docks shall not be located in river mouths or deltas. Artificial gravel islands and bottom-founded structures may not be located in river mouths or active stream channels on river deltas, except as provided in the paragraph above. [Alts. B-E].

28. Two narrow land corridors between Teshekpuk Lake and the Beaufort Sea have been identified as crucial caribou movement corridors. These areas lie northwest and east of Teshekpuk Lake (Fig. E-5). Within these two identified areas, the following requirements may be imposed:
    a. The placement of permanent facilities may be prohibited or restricted; [Alt. E*]
    b. Off-lease site development may be required; [Alt. E*]
    c. Burial of pipelines may be required; [Alt. B-E*]
    d. No permanent surface facilities may be sited within a zone extending 4 miles eastward from the eastern shore of Teshekpuk Lake in the area between the lake and Kogru Inlet, as depicted on Figure E-5. [Alt. E*]

Proponents of modifications to these restrictions must demonstrate to the satisfaction of the AO, in consultation with appropriate Federal, State, and NSB agencies, that such restrictions are not technically, economically, or environmentally practicable and can demonstrate that the goals of the stipulation can be accomplished through alternative means.

29. Use maximum economically feasible extended-reach drilling for production drilling to minimize the number of pads and the network of roads between pads. [Alts. D & E]*

30. All oil and gas facilities, except airstrips, docks, and seawater treatment plants, will be collocated with drill pads. If possible, airstrips will be integrated with roads. Exceptions under Alternative E may be granted or required by BLM in consultation with FWS, if a development is permitted within 3,280 feet of a high-use goose lake. [Alts. D & E*]

31. Within the Teshekpuk Caribou Habitat LUEA, orient linear corridors when laying out oilfield developments to address migration and corralling effects and to avoid loops of road and/or pipeline that connect facilities. [Alts. D-E]

32. Within the Goose Molting Habitat LUEA, oil and gas development activities will avoid alteration of critical goose-feeding habitat types along lakeshore margins (grass/sedge/moss) as identified by the AO in consultation with FWS. [Alt. E]

33. Within the Goose Molting Habitat LUEA, oil and gas facility layout shall incorporate features (e.g. temporary fences, siting/orientation) that screen/shield human activity from view of any goose-molting lake, as identified by the AO in consultation with FWS, within 3 kilometers. [Alt. E]

34. Major construction activities (e.g., sand/gravel extraction and transport, pipeline and pad construction, but not drilling) shall be suspended within the Goose Molting LUEA from June 15 through August 20, unless approved by the AO in consultation with the FWS. [Alts. B-E]

35. Lessees will be required to separate elevated pipelines from roads by 500 feet minimum, if feasible. Examples of where separating roads from pipelines may not be feasible include narrow land corridors between lakes and where pipe and road converge on a drill pad. [Alts. B-E; *]

36. To minimize delay or deflection of caribou movements, lessees should place the pipeline on the appropriate side of the road (depending upon general caribou movements in the area). [Alts. B-E; *]

37. Ramps over pipelines, buried pipe, or pipe buried under the road may be required by the AO, after consultation with ADF&G, in the Teshekpuk Lake Caribou Habitat LUEA where facilities or terrain funnel caribou movement. [Alts. B-E]

38. At a minimum, aboveground pipelines shall be elevated 5 feet, as measured from the ground to the bottom of the pipe, except where the pipeline intersects a road, pad, or a ramp installed to facilitate wildlife passage. The AO, in consultation, with ADF&G, may make an exception if no feasible and prudent way exists to meet the requirement. [Alts. B-E]

39. Surface occupancy for the placement of any oil and gas facility, including roads, airstrips, and pipelines, will be prohibited in the Fish Habitat LUEA at the distances identified.
    a. Ikpikpuk River - a ½-mile setback from the bank of the Ikpikpuk River within the planning area.
    b. Miguakiak River and Teshekpuk Lake - a ½-mile setback from each bank of the Miguakiak River and around the perimeter of Teshekpuk Lake.
    c. Fish Creek - a ¼-mile setback from each bank of Fish Creek and extending the length of BLM-managed lands below the confluence of Inigok Creek.
    d. Judy Creek - a ¼-mile setback from each bank of Judy Creek and extending from the mouth to the confluence of an unnamed tributary in Sec. 8, T.8N., R.2W., Umiat Meridian.
    e. Colville River - a ½-mile setback from the highest high water mark on the western bank of the Colville River and west bank extending the length of BLM managed lands in the planning area.
    f. Deep Water Lakes - a ¼-mile setback around the perimeter of any fish-bearing lake within or partially within the deep lake zone.

    On a case-by-case basis, essential pipeline and road crossings will be permitted through setback areas in those instances where no other suitable sites are available. Stream crossings will be sited perpendicular to the main channel flow; lake crossings will be at the narrowest point. [Alts. B-E]

40. Gravel mining sites required for development activities will be restricted to the minimum necessary to develop the field efficiently and with minimal environmental damage. Where feasible and prudent, gravel sites must be designed and constructed to function as water reservoirs for future use. Gravel mine sites must not be located within an active floodplain of a

watercourses unless the AO, in consultation with ADF&G, determines that there is no feasible and prudent alternative, or that a floodplain site would enhance fish and wildlife habitat after mining operations are completed and the site is closed.

Mine site development and rehabilitation within floodplains must follow the procedures outlined in McLean (1993) *North Slope Gravel Pit Performance Guidelines*, ADF&G Habitat and Restoration Division Technical Report 93-9.

41. Facilities, roads, airstrips, and pipelines will be sited out of the active floodplain of rivers and creeks with a minimum setback of 500 feet and 500 feet away from fish-bearing lake basins. [Alts. B-E).

42. Bridges, rather than culverts, will be utilized for road crossings on all major rivers, as identified by the AO in consultation with the Division of Habitat, ADF&G, to reduce the potential of ice-jam flooding and erosion. Roads shall be designed and sited to minimize the length that is perpendicular to sheet flow. When necessary, on smaller streams culverts will be large enough to not restrict fish passage or adversely affect natural stream flow. [Alts. B-E]

43. The natural drainage pattern will be identified prior to and maintained during and after construction. Any fill placed adjacent to a stream or lake will be armored to limit erosion from flooding or wave action. Cross-drainage structures will be sited, maintained, and properly abandoned to prevent impoundments or alteration of local or areawide hydrology.

44. Dewatering during construction will be conducted using Best Management Practices (BMP's). A current list of BMP's will be available from the AO. [Alts. B-E]

45. No oil and gas surface structures, except approximately perpendicular crossing pipelines and ice pads, shall be built in the Colville River Raptor, Passerine, and Moose Area LUEA. The restriction would not apply within 1½ miles of the Umiat airstrip. [Alts. B-E]

46. No surface structures, except approximately perpendicular pipelines and ice pads, are allowed within the Pik Dunes LUEA. [Alts. C-E]

47. No surface structures, except approximately perpendicular pipelines and ice pads, are allowed within the Ikpikpuk Paleontological Sites LUEA. [Alts. C-E]

48. Lessees must minimize the impact of industrial development on key wetlands. Key wetlands are those wetlands that are important to fish, waterfowl, and shorebirds because of their high value or scarcity in the region. Lessees must identify on a map or aerial photograph the largest surface area, including future expansion areas, within which a facility is to be sited or an activity is to occur. The AO will consult with FWS to identify key wetlands. To minimize impact, the lessee must avoid siting facilities in the identified wetlands unless no feasible and prudent alternatives exist. Key wetland types include (but are not limited to) fish-bearing lakes and streams, riparian shrub, and the following classes described by Bergman et al. (1977): shallow and deep-*Arctophila* ponds, deep-open lakes, basin-complex wetlands, and coastal wetlands.

49. No surface occupancy for oil and gas development will be allowed within 1 mile of known long-term cabins or long-term campsites, except that pipelines and roads would be allowed if they are no closer than ¼ mile from such cabins or campsites. [Alts. B-E]

Ground Transportation

50. The following ground-traffic restrictions will be required on oil and gas development roads in the areas and time periods indicated:
    a. Within the Teshekpuk Lake Caribou LUEA from May 20 through June 20: [Alts. D-E]
        (1) Traffic speed will not exceed 15 mph.
        (2) Traffic will be minimized (a reasonable target would be four convoy round-trips per day between facilities). Nonessential operations requiring vehicles shall be suspended during this time period.
    b. Within the Teshekpuk Lake Caribou LUEA from May 20 through August 1: [Alts. D-E]
        (1) Caribou movement will be monitored.
        (2) Based upon this monitoring, traffic will cease when a crossing by 10 or more appears to be imminent.
    c. Within the Teshekpuk Lake Caribou LUEA from May 20 through August 20: [Alts. D-E]
        (1) To minimize the number of disturbances due to road traffic, convoying will be used.
        (2) To minimize the number of vehicles on the road, personnel will be bussed between worksites and other facilities.
    d. Within the Goose Molting LUEA from June 21 through August 20: [Alt. E]
        (1) Traffic will be minimized (a reasonable target would be four convoy round-trips per day between facilities). Nonessential operations requiring vehicles shall be suspended during this time period.

51. Major equipment, materials, and supplies to be used at oil and gas worksites in the Teshekpuk Lake Caribou LUEA will be stockpiled prior to or after the period May 20 through June 20 to minimize road traffic during that period. [Alts. D-E]

52. Ground vehicles may not be used to chase wildlife.

Air Traffic

(Note: BLM's authority to restrict air traffic is limited to the practices of those parties obtaining authorization to use BLM-administered lands.)

53. Use of aircraft larger than a Twin Otter by authorized users of the study area, including oil and gas lessees, from May 20 through August 20 within the Teshekpuk Lake Caribou LUEA will be for emergency purposes only. [Alts. D-E]

54. Helicopter overflights by oil and gas lessees will be suspended in the Goose Molting LUEA from June 15 through August 20. [Alts. B-E]

55. Fixed-wing aircraft traffic takeoffs and landing by authorized users of the planning area will be limited to an average of one round-trip flight a day from May 20 through June 20 at aircraft facilities in the Teshekpuk Lake Caribou LUEA. Within the Goose Molting LUEA, fixed-wing aircraft use by such users shall be restricted from June 15 to August 20: (a) limited to two round-trip flights/week; (b) restricted to flight corridors established by BLM in consultation with the FWS. [Alts. B-E]

56. Aircraft shall maintain 1,000 feet aboveground level (AGL) (except for takeoffs and landings) over caribou winter ranges during October through May 15, 2,000 feet AGL over the Teshekpuk Lake Caribou Habitat LUEA during May 16 through July 31, unless doing so would endanger human life or violate safe flying practices.

57. Aircraft will maintain an altitude of 1,500 feet AGL when within ½ mile of peregrine falcon nests from April 15 through August 5, unless doing so would endanger human life or violate safe flying practices.

58. Aircraft may not be used to haze wildlife.

Oilfield Abandonment

59. Upon abandonment or expiration of a lease or oil- and gas-related permit, all facilities must be removed and the sites rehabilitated to the satisfaction of the AO, in consultation with ADF&G, ADEC, and NSB. The AO may determine that it is in the best interest of the public to retain some or all of the facilities. [Alts. B-E]

60. Roads, airstrips, and other gravel fill shall be removed or modified upon field abandonment so as to render them unusable for enhanced access into and within the Goose Molting LUEA. [Alt. E]

Subsistence

61. During exploration, development, and production, the lessee shall monitor activity to determine its effects on subsistence and provide reports to BLM and the Subsistence Advisory Panel. [Alts B-E]

62. Lessees shall not unreasonably restrict access in oilfield development areas to subsistence users. [Alts. B-E].
    a. Lessees shall establish procedures for entrance to facilities, the use of roads, and firearms discharge. These procedures will be coordinated through the Subsistence Advisory Panel. In cases where the lessee and the Panel disagree, the AO will determine the appropriate procedure.
    b. Lessees shall develop and distribute information about how to hunt in development areas safely (so equipment is not damaged and people are not endangered) to the communities through newsletters, radio, and signs in both English and Inupiaq.

63. The lessee shall notify the AO of all concerns expressed by subsistence hunters during operations and of steps taken to address such concerns. When conflict arises between subsistence hunters and the lessee over what steps should be taken to address concerns, the AO will resolve the issue [Alts. B-E].

64. Prior to submitting an exploration plan or development and production plan, the lessee shall consult with the potentially affected subsistence community(ies) (e.g., Nuiqsut, Barrow, Atqasuk), the NSB, and the Subsistence Advisory Panel to discuss potential conflicts with the siting, timing, and methods of proposed operations and safeguards or mitigating measures that could be implemented by the operator to prevent unreasonable conflicts. Through this consultation, the lessee shall make every reasonable effort to ensure that exploration, development, and production activities are compatible with subsistence-hunting and -fishing activities and will not result in unreasonable interference with subsistence harvests in the planning area.

    A discussion of resolutions reached during this consultation process and plans for continued consultation shall be included in the exploration plan or development and production plan. In particular, the lessee shall show in the plan how its activities, in combination with other activities in the area, will be scheduled and located to prevent unreasonable conflicts with subsistence activities. Lessees shall also include a discussion of multiple or simultaneous operations, such as ice road construction and seismic activities, that can be expected to occur during operations in order to more accurately assess the potential for cumulative affects. Communities, individuals, and other entities who were involved in the consultation shall be identified in the plan. The lessee shall send a copy of the exploration or development and production plan to the potentially affected community(ies), the NSB, and the Subsistence Advisory Panel at the time they are submitted to BLM to allow concurrent review and comment as part of the plan approval process.

When conflicts between the lessee and other interested parties over what steps should be taken to address concerns can be resolved in no other way, the AO will determine how to resolve the issue. [Alts. B-E]

Orientation Program

65. The lessee shall include in any exploration or development and production plans a proposed orientation program for all personnel involved in exploration or development and production activities (including personnel of lessee's agents, contractors, and subcontractors) for review and approval by the BLM AO. The program shall be designed in sufficient detail to inform individuals working on the project of specific types of environmental, social, and cultural concerns that relate to the northeastern part of the NPR-A. The program shall address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals and provide guidance on how to avoid disturbance. This guidance will include the production and distribution of information cards on endangered and/or threatened species in the planning area. The program shall be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which personnel will be operating. The orientation program shall also include information concerning avoidance of conflicts with subsistence, commercial- fishing activities, and pertinent mitigation.

The program shall be attended at least once a year by all personnel involved in onsite exploration or development and production activities (including personnel of lessee's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in lease activities of the lessee and its agents, contractors, and subcontractors.

Lessees shall maintain a record of all personnel who attend the program onsite for so long as the site is active, though not to exceed 5 years. This record shall include the name and dates(s) of attendance of each attendee. [Alts. B-E]

Traditional Land Use Sites

66. Lessees shall conduct an inventory of known traditional land use sites prior to any field activity. This inventory will include sites listed by the NSB's Inupiat History, Language, and Cultural Commission. Based on this inventory, the lessee shall develop a plan to avoid these sites and to mitigate any damage to them that might occur. The plan will also indicate how access to the site by local subsistence hunters will be provided. Copies of the plan will be submitted to BLM and the Subsistence Advisory Panel with any permit application for exploration or development. [Alts B-E].

Other Activities

67. It is the responsibility of the authorized user to ensure that all people brought to the planning area under its auspices adhere to these stipulations. Therefore, authorized users of the planning area shall provide all employees, contractors, subcontractors, and clients with briefings. The briefings will cover the stipulations applicable to the lease and/or permit. A copy of applicable stipulations will be posted in a conspicuous place in each worksite and campsite.

68. The authorized user shall protect all survey monuments and be responsible for survey costs if remonumentation is needed as the result of the user's actions.

69. A letter of nonobjection from the surface landowner or the Native corporation(s) that have selected surface lands will be required to be on file with the AO before entry on those lands.

70. All activities shall be conducted so as to avoid or minimize disturbance to vegetation.

71. The Bureau of Land Management, through the AO, reserves the right to impose closure of any area to operators in periods when fire danger or other dangers to natural resources are severe.

72. The authorized user shall be financially responsible for any damage done by a wildfire caused by its operations.

73. Construction camps will not be located on frozen lakes or on river ice. The location of construction camps on river sand and gravel bars is allowed and, where feasible, encouraged. Where leveling of trailers or modules is required and the surface has a vegetative mat, leveling will be accomplished with blocking rather than leveling with a bulldozer.

74. Use of pesticides without the specific authority of the AO is prohibited.

75. The feeding of all wildlife by authorized users is prohibited.

76. Hunting by lessees employees and by agents and contractors is prohibited. [Alts. B-E]

77. Off-pad activities by lessees, contractors, subcontractors, and their employees shall be prohibited within the Goose Molting LUEA from June 15 through August 20, except in emergencies or if approved by the AO. [Alt. E]

78. Public access except by subsistence users to goose-molting areas by way of or through the use of oilfield facilities is prohibited. [Alt. E]

79. Upon finding any cultural or paleontological resource, the authorized user, or his or her designated representative, shall notify the AO and suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the AO.

80. Petroleum exploration and production activities must not be conducted within ½ mile of occupied grizzly bear dens, unless alternative mitigative measures are approved by the AO in consultation with ADF&G.

81. Oil and gas lessees and their contractors and subcontractors will prepare and implement bear-interaction plans to minimize conflicts between bears and humans. These plans shall include measures to (a) minimize attraction of bears to the drill sites; (b) organize layout of buildings and work areas to minimize human/bear interactions; (c) warn personnel of bears near or on drill sites and the proper procedures to take; (d) if authorized, deter bears from the drill site; (e) provide contingencies in the event bears do not leave the site or cannot be deterred by authorized personnel; (f) discuss proper storage and disposal of materials that may be toxic to bears; and (g) provide a systematic record of bears on the site and in the immediate area. The lessee's shall develop educational programs and camp layout and management plans as they prepare their lease operations plans. These plans shall be developed in consultation with FWS and ADF&G and submitted to the AO.

82. Structures shall be restricted to an area at least 100 feet from the nearest body of water or stream.

D. COMPARISON OF ALTERNATIVES: Table II.D.1 summarizes some key management actions proposed under each alternative. For a complete list of stipulations for each alternative, readers should refer to Section II.C.7. For the management constraints associated with Wild and Scenic River designations, readers should consult Appendix G. Table II.D.2 summarizes the impacts of the first sale under each alternative and the impacts of the multiple sale scenario for each alternative.

E. NEED FOR FURTHER NEPA ANALYSIS: Additional NEPA analysis would be required for any management decision that goes beyond the scope of this document. Where possible, the analysis would tier from this IAP/EIS.

One important aspect of this document is a possible oil and gas leasing program. It is the subject of much of the analysis in Section IV. In compliance with current Council on Environmental Quality regulations, part of this analysis relies on a hypothetical development scenario based on general information about where there is high potential for oil and gas in the study area and current industry exploration and development practices. While this analysis is adequate for oil and gas leasing, any further development, including an exploratory drilling program or the construction of the infrastructure necessary for development of an oil discovery, would require further NEPA analysis based on specific and detailed information about where and what kind of activity would occur. This analysis would result in the appropriate NEPA documentation for specific projects.

The analysis contained in this IAP/EIS addresses the overall impacts of making certain lands available for oil and gas leasing. It also analyzes the impacts of a first sale and will act as NEPA documentation for that sale. Subsequent sales are authorized under Alternatives B through E. Prior to conducting each additional sale, the agency will conduct a NEPA analysis, tiering from the IAP/EIS. If the analysis in the IAP/EIS is deemed to be valid, the NEPA analysis for the second and subsequent sales may only require an administrative determination or an Environmental Assessment.

F. INTERRELATIONSHIPS:

1. Introduction: Many Federal laws and executive orders apply in one way or another to the planning and

Table II.D.1
Comparison of Management Actions

PORTION OF THE PLANNING AREA	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C	ALTERNATIVE D	ALTERNATIVE E
Teshekpuk Lake Watershed LUEA	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing.	•Available to oil and gas leasing except that portion within the Teshekpuk Lake Caribou Habitat and the Goose Molting Habitat LUEA's.	•Available to oil and gas leasing except that portion within the Goose Molting Habitat LUEA.	•Available to oil and gas leasing.
Goose Molting Habitat LUEA	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing.	•Available to oil and gas leasing.
Spectacled Eider Nesting Concentrations LUEA	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing (by closure of Teshekpuk Lake Caribou Habitat LUEA, which overlies the LUEA).	•Available to oil and gas leasing except that portion within the Goose Molting Habitat LUEA.	•Available to oil and gas leasing.
Teshekpuk Lake Caribou Habitat LUEA	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing.	•Available to oil and gas leasing except that portion within the Goose Molting Habitat LUEA.	•Available to oil and gas leasing.
Fish Habitat LUEA	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing.	•Available to oil and gas leasing except that portion within the Teshekpuk Lake Caribou Habitat and the Goose Molting Habitat LUEA's.	•Available to oil and gas leasing except that portion within the Goose Molting Habitat LUEA.	•Available to oil and gas leasing.
Colville River Raptor, Passerine, and Moose Area LUEA	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing. •Propose a portion of the LUEA as part of a Bird Conservation Area.	•Available to oil and gas leasing. •Propose a portion of the LUEA as part of a Bird Conservation Area.	•Available to oil and gas leasing. •Propose a portion of the LUEA as part of a Bird Conservation Area.	•Available to oil and gas leasing. •Propose a portion of the LUEA as part of a Bird Conservation Area.
Umiat Recreation Site LUEA	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing. •In cooperation with the State, establish Umiat primitive campsite/air park and trail.	•Available to oil and gas leasing. •In cooperation with the State, establish Umiat primitive campsite/air park and trail.	•Available to oil and gas leasing. •In cooperation with the State, establish Umiat primitive campsite/air park and trail.	•Unavailable to oil and gas leasing. •In cooperation with the State, establish Umiat primitive campsite/air park and trail.
Scenic Areas LUEA	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing. •Establish VRM Class I on the Colville River.*	•Available to oil and gas leasing. •Establish VRM Class II on the upper Colville River. •Estabalish VRM Class III ont he lower Colville River, including Umiat.*	•Available to oil and gas leasing. •Establish VRM Class II on the upper Colville River. •Estabalish VRM Class III ont he lower Colville River, including Umiat.*	•Available to oil and gas leasing. •Establish VRM Class II on the upper Colville River. •Estabalish VRM Class III ont he lower Colville River, including Umiat.*

47

TABLE II.D.1

PORTION OF THE PLANNING AREA	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C	ALTERNATIVE D	ALTERNATIVE E
Pik Dunes LUEA	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing. •Recommend the Secretary of the Interior add the dunes to the Teshekpuk Lake Special Area.	•Available to oil and gas leasing. •Recommend the Secretary of the Interior add the dunes to the Teshekpuk Lake Special Area.	•Available to oil and gas leasing. •Recommend the Secretary of the Interior add the dunes to the Teshekpuk Lake Special Area.	•Available to oil and gas leasing. •Recommend the Secretary of the Interior add the dunes to the Teshekpuk Lake Special Area.
Ikpikpuk Paleontological Sites	•Unavailable to oil and gas leasing.	•Unavailable to oil and gas leasing. •Recommend the Secretary of the Interior establish a Special Area on the Ikpikpuk River.	•Available to oil and gas leasing except the portion within the Teshekpuk Lake Caribou Habitat LUEA. •Recommend the Secretary of the Interior establish a Special Area on the Ikpikpuk River.	•Available to oil and gas leasing. •Recommend the Secretary of the Interior establish a Special Area on the Ikpikpuk River.	•Available to oil and gas leasing. •Recommend the Secretary of the Interior establish a Special Area on the Ikpikpuk River.
Kuukpik Corporation Entitlement LUEA	•Unavailable to oil and gas leasing.	•Deferred from oil and gas leasing until Kuukpik Corporation's entitlement has been conveyed.	•Available to oil and gas leasing. •Escrow royalties.	•Available to oil and gas leasing. •Escrow royalties.	•Available to oil and gas leasing. •Escrow royalties.
Potential Colville Wild and Scenic River LUEA	•Unavailable to oil and gas leasing. •Make no recommendation for WSRS designation.	•Unavailable to oil and gas leasing. •Recommend as a component of the WSRS to be managed as a "wild" river area. •Establish VRM Class I.*	•Available to oil and gas leasing. •Recommend as a component of the WSRS to be managed as a "scenic" river area. •Establish VRM Class II on upper portion. •Establish VRM Class III on lower portion.*	•Available to oil and gas leasing. •Recommend as a component of the WSRS to be managed as a "recreational" river area. •Establish VRM Class II on upper portion. •Establish VRM Class III on lower Colville River.*	•Available to oil and gas leasing. •Find the river to be unsuitable as a component of the WSRS. •Establish VRM Class II on upper Colville River. •Establish VRM Class III on lower portion.*
Other Federal lands.	•Unavailable to oil and gas leasing.	•Available to oil and gas leasing.	•Available to oil and gas leasing.	•Available to oil and gas leasing.	•Available to oil and gas leasing.

Stipulations listed in Section II.C.7 will protect important surface resources by restricting where, when, and how certain activities, including oil and gas exploration and development, can occur. The scope of stipulations increases between Alternative A and Alternative E as the resources potentially impacted by oil and gas leasing increase.
Winter seismic operations throughout the planning area would be allowed under all alternatives, except that Alternative A contains two options, one allowing seismic and one prohibiting it.
*Visual Resource Management classes are described in Appendix H.

permitting process for any development, including an oil and gas program, in the NPR-A. Some of the major laws and executive orders include the Endangered Species Act, National Historic Preservation Act (NHPA), Coastal Zone Management Act (CZMA), Wild and Scenic Rivers Act (WSRA), Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA), Clean Air Act (CAA), Clean Water Act (CWA), Rivers and Harbors Act of 1899, the Fish and Wildlife Coordination Act, and Executive Order 12898 on Environmental Justice.

2. Endangered Species Act and National Historic Preservation Act Consultation and Coastal Zone Management: The ESA specifies consultation with the FWS and the National Marine Fisheries Service, while the NHPA requires consultation with the Alaska State Historic Preservation Officer and the President's Advisory Council on Historic Preservation. The BLM has initiated these consultations and will complete them prior to publishing the final EIS. The BLM also is working with the State of Alaska through its representative on the planning team to ensure that the mandates of the CZMA are met. The required compliance documentation will be included in the final EIS.

3. Wild and Scenic Rivers Act Compliance: The WSRA requires that BLM address wild and scenic river values in its planning efforts. This responsibility was reaffirmed in an out-of-court settlement with the organization American Rivers in 1994. In this planning effort, BLM is reevaluating studies previously completed pursuant to Section 105(c) of the NPRPA. Using these studies as a base, BLM is including in the alternatives in Section II.C four possible options for managing the wild and scenic values of the Colville River.

4. Alaska National Interest Lands Claims Act Section 810 Compliance: Appendix D contains an evaluation and finding of effects on subsistence that is required by Section 810 of ANILCA. Public hearings seeking comment on this evaluation will be held concurrently with the public meetings required for this draft EIS.

5. Future Interrelationships: Compliance with the requirements of the CWA, the CAA, and the Rivers and Harbors Act of 1899 will occur if and when BLM considers authorizing specific exploratory drilling or oilfield development. These future decisions would require NEPA documentation and coordination with many Federal, State, or NSB agencies before the necessary permits for these activities could be issued. The BLM would ensure that any permittee had attained the proper permits/authorizations from those agencies before approving proposed activities. In developing NEPA documentation for any such future activities, it would be necessary to consider some of the data needs of these agencies so that they could either use the document or tier off of it for any additional required analysis.

The following discussion focuses on some of the permits that would be required by various agencies during any developmental activities in the planning area.

The U.S. Army Corps of Engineers (COE) administers two relevant permits. The first is issued pursuant to Section 404 of the CWA, which addresses wetlands. In order to meet Section 404 requirements, any future NEPA document would describe the project's components, identify the type and amount of wetlands and other waters affected by each alternative, describe anticipated impacts, and discuss mitigation measures that could minimize impacts to these resources.

Section 10 of the Rivers and Harbors Act of 1899 is the source for the second COE-administered permit. To address the requirements of this section, any future NEPA document would have to describe the navigable waters of the United States within the project area and how structures in, on, or over these waters would affect them during construction and operation. The NEPA document would describe the alternatives and compare possible impacts to coastal integrity and navigation from each alternative. It also would discuss mitigating measures to minimize these impacts.

The USEPA issues NPDES permits require by the CWA. In order to provide information for these permits, any future NEPA document would describe existing water quality and the quantity of water requirements for the proposed project; expected pollutants and their concentrations; and the quality and locations of wastewater treatment facilities and discharges. The USEPA administers and the ADEC issues other CWA- mandated permits for Waste Water Authorization, Oil Discharge Prevention and Contingency Plans, Storm Water Discharge, and Underground Injection Authorizations.

The USEPA also issues Prevention of Significant Deterioration (PSD) air-quality permits required by the CAA, while the ADEC issues other air-quality permits. A future NEPA document would provide an analysis of meteorological factors and air-quality baseline conditions and predict impacts to air quality during construction and operations in order to facilitate the issuance of these permits.

Permittees involved in oil and gas exploration and development in the planning area are also required to secure various permits from State agencies that have received delegated Federal authority or have primary State authority to implement specific environmental protection laws. Required permits address issues such as air quality, water quality and water use, fish habitat, spill-contingency planning, solid-waste disposal, storage and injection of drilling and production wastes, and drilling authorization.

The NSB requires that it issue a permit before any exploratory or developmental operation can occur within the Borough, including lands within the planning area. Under the NSB zoning ordinance, any acreage leased within the planning area would require rezoning from the Borough's Conservation Zoning District to its Resource Development District before oil and gas development could occur.

6. Subsistence Advisory Panel: In order to ensure local participation in the decisionmaking process as it relates to subsistence, BLM will establish a local Subsistence Advisory Panel under Alternatives B through E. The responsibilities of this panel will be to:

(a) provide recommendations to BLM concerning planning, research, monitoring, and assessment activities needed to facilitate responsible development and protect subsistence resources and uses in the NPR-A;
(b) identify potential conflicts between subsistence use and other resource uses;
(c) inform local communities and agencies about panel activities and agency actions concerning subsistence protection in the planning area;
(d) work with the NSB to maintain a repository of subsistence information concerning the planning area for local communities and agencies;
(e) help BLM to ensure continuity and consistency in the collection and use of subsistence information by the advisory panel and other groups.

The panel will review resource-related development plans and make recommendations to BLM regarding whether they adequately consider subsistence. The BLM will work with the panel and any permittees to resolve conflicts between subsistence use and resource development. The BLM will work closely with the panel to develop a program to monitor the effects of development on subsistence resources and users. Should monitoring identify the existence of impacts on subsistence uses, the panel will make recommendations to BLM regarding (a) additional mitigating measures, (b) potential relocation of operations or redesign of facilities, and (c) more effective mechanisms for enforcement of subsistence stipulations.

The exact membership of and method for creating the panel will be determined by BLM in consultation with the NSB, the State of Alaska, and the FWS Subsistence Division prior to the beginning of an oil and gas leasing program in the planning area. In development of the panel, BLM will consider combining the work of the panel with other existing and proposed local advisory groups. The provisions of the Federal Advisory Committee Act will be followed.

G. ALTERNATIVES AND ISSUES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS: The public raised a number of issues which fall beyond the scope of this plan. Some matters would require Federal legislation. These include opening the planning area to allow mining of hard-rock minerals, the establishment of wilderness areas, and the transfer of lands from BLM management to another Federal Agency. With the exception of Wild and Scenic Rivers, which law requires BLM examine as part of its analysis, this plan is limited to address those issues that do not require legislation.

Some would have preferred that the plan address all of the NPR-A. The BLM considered this possibility prior to issuing the Notice of Intent to Plan in February 1997. The agency, however, determined to focus its analysis on the area of greatest interest for oil and gas development. The northeast portion of the NPR-A is closest to the existing petroleum infrastructure. The small to medium oilfields that are considered the most likely to exist in the NPR-A would not justify extension of that infrastructure to the central and western parts of the Reserve until and unless other small to medium fields are found and developed in the northeast part of the Reserve.

Scoping comments also indicated that land exchanges with other landholders should be considered in this plan. The ASRC felt that a great injustice had been done by not allowing the Inupiat to select lands within the NPR-A in 1971 when ANCSA was adopted. In their view, a land exchange could help correct this. This document does not directly address the issue of land exchanges. Applying BLM criteria for identification of lands desirable for disposal or retention, lands within the planning area have been identified as being desirable for retention. However, if a specific land exchange is proposed and can be shown to be in the public interest, after appropriate analysis and documentation, an exchange could be considered.

Issues related to existing structures, primarily cabins, also are not addressed in this document. The BLM will be working with the NSB to determine the extent and potential resolution of this issue within existing policy and procedures.

This IAP/EIS also does not address where a pipeline servicing a field outside the planning area might cross the planning area. Offshore State or Federal leasing in the Beaufort Sea may lead to development directly to the north of the planning area. If a pipeline from such a development across the planning area to the existing infrastructure is proposed, it would require separate legal authorization and environmental analysis.

The NPR-A Subsistence Impact Analysis Workshop convened by BLM with the help of the State of Alaska and the NSB on August 19-21, 1997, in Nuiqsut developed a number of recommendations (Appendix F). Many of these recommendations in their original or modified form have been incorporated into the alternatives as management actions or stipulations. Two recommendations dealing with training and hiring programs and compensation for losses have been eliminated from detailed analysis, because they were determined to be beyond BLM's legal authorities.

Table II.D.2

Comparisons of Impacts for Alternatives A, B, C, D, and E, and the Cumulative Case for the National Petroleum Reserve — Alaska Planning Area Integrated Activity Plan/ Environmental Impact Statement

Soils
Paleontological Resources
Water Resources
Water Quality
Air Quality
Vegetation
Fish
Birds
Mammals — Terrestrial
Mammals — Marine
Endangered and Threatened Species
Economy
Subsistence-Harvest Patterns
Sociocultural Systems
Coastal Zone Management
Recreational and Visual Resources

The summaries presented in this table are based on the comprehensive analysis in Sections IV.B, C, D, E, F, and G of an Integrated Activity Plan/Environmental Impact Statement.

SOILS

Alternative A	Alternative B	Alternative C
Soil stability is closely dependent on vegetative cover; where vegetation is disturbed impacts on soils follow. Impacts to soils from management actions under Alternative A would involve either disturbance or destruction of relatively small areas. The duration of these impacts may be short term, ranging from several years if the vegetation is disturbed and up to many decades if the soils are destroyed. Soil recovery is much slower than that of vegetation. Relatively, the overall impact to soils in the planning area is expected to be just a few acres compared to a total of more than four million acres in the whole planning area.	Areas of impacts and losses of soils from all activities are similar to those areas discussed under vegetation.	**First Sale**. Estimated areas of impacts and losses of soils from all activities are similar to those areas discussed under vegetation.
	Multiple Sales. Areas of impacts and losses of soils from all activities in multiple sales are similar to those areas discussed under vegetation.	**Multiple Sales**. Areas of impacts and losses of soils from all activities in multiple sales are similar to those areas discussed under vegetation.

PALEONTOLOGICAL RESOURCES

Alternative A	Alternative B	Alternative C
Potential impacts to paleontological resources would result from management activities other than oil and gas exploration (except seismic activity) and development. These impacts can be satisfactorily addressed through the current assessment and decisionmaking process.	**First Sale**: Potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative A. Under Alternative B, the potential impacts to paleontological resources from oil and gas exploration and development may be the same as or only slightly increased from the impacts from activities other than oil and gas under Alternative A.	**First Sale**: Potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature but may be somewhat increased in magnitude over Alternative B. Under Alternative C, most of the impacts to paleontological resources would result from oil and gas exploration and development. When compared with Alternative B, the potential for impact to paleontological resources may range from similar to Alternative A to somewhat greater under Alternative C.
	Multiple Sales. Potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative A, but the probability of impacts occurring might increase. Under Alternative B, the potential impacts to paleontological resources from oil and gas exploration and development would increase dramatically compared to Alternative A, because only seismic activities would be permitted under Alternative A.	**Multiple Sales**: Potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under Alternative C, the potential impacts to paleontological resources from oil and gas exploration and development would increase by roughly 20 percent compared to Alternative B.

SOILS

Alternative D	Alternative E	Cumulative Case
First Sale. Estimated areas of impacts and losses of soils from all activities are similar to those areas discussed under vegetation.	**First Sale.** Estimated areas of impacts and losses of soils from all activities are similar to those areas discussed under vegetation.	Estimated areas of impacts and losses of soils from all activities are similar to those areas discussed under vegetation.
Multiple Sales. Areas of impacts and losses of soils from all activities in multiple sales are similar to those areas discussed under vegetation.	**Multiple Sales.** Areas of impacts and losses of soils from all activities in multiple sales are similar to those areas discussed under vegetation.	

PALEONTOLOGICAL RESOURCES

Alternative D	Alternative E	Cumulative Case
First Sale. Potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature but may be significantly increased in magnitude over Alternative B. Under Alternative D, most of the impacts to paleontological resources would result from oil and gas exploration and development. When compared with Alternative B, the potential for impact to paleontological resources would be significantly greater under Alternative D.	**First Sale.** Potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature but may be significantly increased in magnitude over Alternative B.	Overall, cumulative impacts would be most probable and similar in nature and intensity to those described in Alternative E.
Multiple Sales. Potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under Alternative D, the potential impacts to paleontological resources from oil and gas exploration and development would increase by at least 300 percent compared to Alternative B.	**Multiple Sales.** Potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under Alternative E, the potential impacts to paleontological resources from oil and gas exploration and development would increase by at least 400 percent compared to Alternative B.	

WATER RESOURCES		
Alternative A	**Alternative B**	**Alternative C**
Impacts to water resources under Alternative A would be minimal and of short duration.	**First Sale**: The impacts of activities other than oil and gas exploration and development under Alternative B are expected to be the same as under Alternative A. The potential short-term impacts, primarily during construction, would increase erosion and sedimentation and water removal from riverine pools and lakes. The potential long-term impacts of oil and gas development activities on the water resources in the planning area include: disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst) and blockages of natural channels and floodways that disrupt drainage patterns. While any surface-disturbing activity could affect water resources, the potential adverse effects of Alternative B, because it excludes the critical lake and river habitat from leasing, while significant, will be the least of all the leasing options.	**First Sale**: The impacts of activities other than oil and gas exploration and development under Alternative C are expected to be the greater than under Alternative A (and greater than those under Alternative B). The potential long-term impacts (melting of permafrost and disrupting drainage patterns) and short-term impacts (increasing erosion and sedimentation and removing water from riverine pools and lakes) of oil and gas exploration and development on the water resources on the planning area is expected to be greater for Alternative C than for Alternative B.
	Multiple Sales: Shared infrastructure could reduce the adverse effects to water resources of multiple lease sales.	**Multiple Sales**: Shared infrastructure could reduce the adverse effects to water resources of multiple lease sales.

WATER RESOURCES		
Alternative D	**Alternative E**	**Cumulative Case**
First Sale: The impacts of activities other than oil and gas exploration and development under Alternative D are expected to be the greater than those under Alternative B and C. The potential long-term impacts (melting of permafrost, and disrupting drainage patterns) and short-term impacts (increasing erosion and sedimentation and removing water from riverine pools and lakes) of oil and gas exploration and development on the water resources in the planning is expected to be greater for Alternative D than for Alternatives B and C.	**First Sale**: The impacts of activities other than oil and gas exploration and development under Alternative E are expected to be the greater than under Alternative A (and greater than Alternative D). The potential long-term impacts (melting of permafrost and disrupting drainage patterns) and short-term impacts (increasing erosion and sedimentation and removing water from riverine pools and lakes) of oil and gas exploration and development on the water resources in the planning is expected to be greater for Alternative E than for Alternatives B and D.	The cumulative effects of oil and gas exploration and development on water resources would include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst), blockages of natural channels and floodways that disrupt drainage patterns, increased erosion and sedimentation, and removal of gravel from riverine pools and lakes. These effects could cause long-term changes in stream-bank and lakeshore stability, diversions from natural drainage patterns, and variations in stream-channel and lakeshore sand- and gravel-bar formation. These effects could be reduced but not completely eliminated through application of stipulations. The cumulative effects of oil and gas exploration and development on water resources may be up to several times greater than those estimated for Alternative E.
Multiple Sales: Shared infrastructure could reduce the adverse effects to water resources of multiple lease sales.	**Multiple Sales**: Shared infrastructure could reduce the adverse effects to water resources of multiple sales.	

WATER QUALITY		
Alternative A	**Alternative B**	**Alternative C**
Long-term water quality over about a total of 900 acres would be affected by biannual 2-D seismic programs under Alternative A.	**First Sale**: Longer-term (decade-or-more) effects of Alternative B would be about twice that for Alternative A because of the introduction of oil and gas activities, especially additional seismic activities. Additionally, water quality over a few hundred acres could be annually affected by construction or placement of ice roads. Oil spills could result in waters of about six ponds or small lakes remaining toxic to sensitive species for about 7 years.	**First Sale**. Effects under Alternative C are similar to those in Alternative B for oil and gas activities, and similar to those for Alternative A for activities other than oil and gas. Annually, water quality over 2,000 acres could be affected by seismic trails, construction or placement of ice or gravel roads, and other structures. Oil spills could result in waters of up to seven ponds or small lakes remaining toxic to sensitive species for about 7 years.
	Multiple Sales. Longer-term (decade-or-more) effects of multiple sales would be similar to those for a single sale. Oil spills could result in waters of about eight ponds or small lakes remaining toxic to sensitive species for about 7 years.	**Multiple Sales**. Longer-term (decade-or-more) effects of multiple sales would be slightly greater than for a single sale. Oil spills could result in waters of up to nine ponds or small lakes remaining toxic to sensitive species for about 7 years.

AIR QUALITY		
Alternative A	**Alternative B**	**Alternative C**
Air quality would not be affected by air-impacting actions within the planning area under Alternative A.	**First Sale**. Activity associated with Alternative B would result in a small, localized increase in the concentrations of criteria pollutants. Concentrations would be within the PSD Class II limits and National Air Quality Standards. Therefore, effects from Alternative B would be low. Effects of activities other than oil and gas are negligible, as in Alternative A.	**First Sale**. The impacts of oil and gas activities under Alternate C would be similar to those under Alternative B. Annually, air quality would be affected by drilling and construction activities at levels less than the PSD criteria. Effects of activities other than oil and gas are negligible, as in Alternative A.
	Multiple Sales. Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.	**Multiple Sales**. Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.

57

WATER QUALITY

Alternative D	Alternative E	Cumulative Case
First Sale. Effects under Alternative D are higher than in Alternative B for oil and gas activities. Effects for activities other than oil and gas are similar to those for Alternative A. Annually, water quality up to 3,000 acres could be affected by seismic trails, construction or placement of ice or gravel roads and other structures. Oil spills could result in waters of up to 13 ponds or small lakes remaining toxic to sensitive species for about 7 years.	**First Sale**: Effects of oil and gas activities in Alternative E would be higher than in Alternative B. Effects of other activities would be similar to those in Alternative A. Long term water quality over >3,000 acres could be affected by seismic trails, construction or placement of gravel roads, and other structures. Oil spills could result in waters of up to 18 ponds or small lakes remaining toxic to sensitive species for about 7 years. Tankering of oil is projected to result in a most likely number of zero to one spills of ≥1,000 bbl along multiple TAP tanker routes. Such a spill would contaminate receiving water over several tens of mi² to levels above chronic criteria but below acute criteria.	**Conclusion:** The IAP action constitutes the cumulative case for freshwater within the planning area, but only a small percent (0-15%) of the marine cumulative for water quality.
Multiple Sales. Longer-term (decade-or-more) effects of multiple sales would slightly greater than for a single sale. Oil spills could result in waters of up to 27 ponds or small lakes remaining toxic to sensitive species for about 7 years.	**Multiple Sales**. Longer-term (decade-or-more) effects of multiple sales would be one-third greater than for a single sale. Oil spills could result in waters of up to 36 ponds or small lakes remaining toxic to sensitive species for about 7 years. The ≤2 most likely number of tanker spills along TAPS routes could individually contaminate receiving water over several tens of nmi² to levels above chronic criteria but below acute criteria	

AIR QUALITY

Alternative D	Alternative E	Cumulative Case
First Sale: Effects of oil and gas activities under Alternative D are similar to those under Alternative C. Annually, air quality would be affected by drilling and construction activities at levels less than the PSD criteria. Effects of activities other than oil and gas are negligible, as in Alternative A.	**First Sale**: Effects of oil and gas activities under Alternate E would be similar to those under Alternative D. Annually, air quality would be affected by drilling and construction activities at levels less than the PSD criteria. Effects of activities other than oil and gas would be negligible, the same as under Alternative A.	The overall cumulative effects would be monitored and controlled through the permitting process. Effects would be negligible.
Multiple Sales: Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.	**Multiple Sales**: Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.	

VEGETATION

Alternative A	Alternative B	Alternative C
Impacts to vegetation from management actions under Alternative A would involve either disturbance or destruction. The duration of these impacts would be short term, ranging up to 5 months, and complete recovery could vary from 1 year to decades. The overall impact to the vegetation communities of the 4.6-million-acre planning area would be minor to negligible.	**First Sale**: Impacts to vegetation from activities other than oil exploration and development under Alternative B would be the same as those under Alternative A, except that the effects of archaeological excavation might increase from 1 to 2 acres. The impacts of oil exploration would include vegetation disturbance on about 7,350 acres per year from 2-D seismic work and 0 to 92,120 acres from 3-D surveys. About 17 percent of the disturbance from 2-D would be medium to high, with perhaps 20 percent at that level for 3-D. After 9 years, recovery would be about 90 percent for 2-D seismic work and probably somewhat less for 3-D. Exploration activities also would result in minor vegetation destruction and alteration from the construction of exploration well collars that would be permanent. The activities of oilfield development would cause the destruction of vegetation on 0 to 180 acres and the alteration in plant species composition of another 0 to 280 acres, for a total of effects over 0 to 460 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills affect 0.0 to 2.6 acres of vegetation. Spills would be cleaned up immediately, would cause minor ecological damage, and ecosystems would be likely to recover in a few years to 2 decades.	**First Sale**: Impacts to vegetation from activities other than oil exploration and development under Alternative C would be the same as those under Alternative A, except that the effects of archaeological excavation might increase from 1 to 4 acres. The impacts of oil exploration and development would be of the same types as for Alternative B but greater in areal extent. The maximum acreage affected by 3-D seismic surveys would increase from 0 to 92,000 acres to 46,000 to 138,000 acres. The combined effect of development activities would cause the destruction of vegetation on 140 to 320 acres rather than 0 to 180 acres and the alteration in plant species composition of another 220 to 500 acres instead of 0 to 280 acres, for a total of effects over 360 to 820 acres rather than 0 to 460 acres. Finally, the occurrence of spills would increase, affecting 0.5 to 3.0 acres instead of 0.5 to 2.6 acres.
	Multiple Sales: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in only a small increase in the amount of disturbance that would be evident at any one time. Exploration activities also would result in 0.02 to 0.2 acres of permanent vegetation destruction around well collars and alteration of 0.1 to 0.7 acres around ice pads. The activities of oilfield development would cause the destruction of vegetation on 0 to 320 acres and the alteration in plant species composition of another 0 to 500 acres, for a total of effects over 0 to 820 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills would affect 0.0 to 3.7 acres of vegetation within the planning area. Recovery from spills would take a few years to two decades.	**Multiple Sales**: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time. Exploration activities also would result in 0.05 to 0.2 acres of permanent vegetation destruction around well collars and alteration of 0.2 to 0.8 acres around ice pads. The activities of oilfield development would cause the destruction of vegetation on 140 to 460 acres and the alteration in plant species composition of another 220 to 720 acres, for a total of effects over 360 to 1,160 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills would affect 0.8 to 4.2 acres of vegetation within the planning area. Recovery from spills would take a few years to two decades.

<table>
<tr><th colspan="3">VEGETATION</th></tr>
<tr><th>Alternative D</th><th>Alternative E</th><th>Cumulative Case</th></tr>
<tr><td>First Sale: Impacts to vegetation from activities other than oil exploration and development under Alternative D would be the same as those under Alternative A, except that the effects of archaeological excavation might increase from 1 to 5 acres. The impacts of oil exploration and development would be of the same types as for Alternative B, but greater in areal extent. The maximum acreage affected by 3-D seismic surveys would increase from 0 to 92,000 acres to 92,000 to 322,000 acres. The combined effect of development activities would cause the destruction of vegetation on 140 to 600 acres rather than 0 to 180 acres and the alteration in plant species composition of another 220 to 940 acres instead of 0 to 280 acres, for a total of effects over 360 to 1,540 acres rather than 0 to 460 acres. Finally, the occurrence of spills would increase, affecting 1.4 to 6.0 acres instead of 0.5 to 2.6 acres.</td><td>First Sale: Impacts to vegetation from activities other than oil exploration and development under Alternative E would be the same as those under Alternative A, except that the effects of archaeological excavation might increase from 1 to 6 acres. The impacts of oil exploration and development would be of the same types as for Alternative B, but greater in areal extent. The maximum acreage affected by 3-D seismic surveys would increase from 0 to 92,000 acres to 92,000 to 460,000 acres. The combined effect of development activities would cause the destruction of vegetation on 140 to 780 acres rather than 0 to 180 acres and the alteration in plant species composition of another 220 to 1,220 acres instead of 0 to 280 acres, for a total of effects over 360 to 2,000 acres rather than 0 to 460 acres. Finally, the occurrence of spills would increase, affecting 1.8 to 8.0 acres under Alternative E instead of 0.5 to 2.6 acres under Alternative B.</td><td rowspan="2">The impacts of Alternative E, multiple sales, on the vegetation of Alaska's North Slope, both from construction of infrastructure and from oil spills, are expected to represent a small (6-15%) but measurable proportion of the cumulative impacts to vegetation from oil development. These cumulative impacts are expected to affect <2 percent of the vegetation of the Arctic Coastal Plain, which is the most heavily impacted of the three physiographic provinces of the North Slope.</td></tr>
<tr><td>Multiple Sales: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time. Exploration activities would also result in 0.1 to 0.5 acres of permanent vegetation destruction around well collars and alteration of 0.6 to 2.0 acres around ice pads. The activities of oilfield development would cause the destruction of vegetation on 280 to 1,020 acres and the alteration in plant species composition of another 440 to 1,000 acres, for a total of effects over 720 to 2,620 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends. Oil spills would affect 2.7 to 12.0 acres of vegetation within the planning area. Recovery from spills would take a few years to 2 decades.</td><td>Multiple Sales: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time. Exploration activities would also result in 0.2 to 0.6 acres of permanent vegetation destruction around well collars and alteration of 0.7 to 2.7 acres around ice pads. The activities of oilfield development would cause the destruction of vegetation on 280 to 1,480 acres and the alteration in plant species composition of another 440 to 2,320 acres, for a total of effects over 720 to 3,800 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends. Oil spills would affect 3.7 to 16.0 acres of vegetation within the planning area. Recovery from spills would take a few years to 2 decades.</td></tr>
</table>

FISH

Alternative A	Alternative B	Alternative C
Fuel spills are expected to lethally or sublethally affect a small number of the fish in the planning area over the life of BLM's management plan. Recovery from each spill affecting fish is expected within 3 years.	**First Sale** Fuel spills associated with Alternative B are expected to have a similar effect on arctic fish populations as discussed for Alternative A. Seismic surveys and construction related actions are expected to have no measurable effect on arctic fish populations in the planning area. Oil spills are expected to lethally or sublethally affect a small number of fish in the planning area over the production life of the field. Recovery from each spill affecting fish is expected within 3 years.	First Sale. The effect of fuel spills on arctic fish populations in Alternative C are expected to be similar to Alternative A. The individual effects of seismic surveys, construction related activities, and oil spills are expected to be similar to that of Alternative B. However, the likelihood of their occurrence is estimated to be roughly two to three times higher for Alternative C than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of these activities on arctic fish populations in Alternative C over that of Alternative B.
	Multiple Sales Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish populations as the first sale. Gravel pads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish populations than the first sale. Insufficient recovery time between sales and or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.	**Multiple Sales** Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish as the first sale. Gravel pads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish than the first sale. Insufficient recovery time between sales and or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.

61

FISH

Alternative D	Alternative E	Cumulative Case
First Sale: The effect of fuel spills on arctic fish populations in Alternative D are expected to be similar to Alternative A. The individual effects of seismic surveys, construction related activities, and oil spills are expected to be similar to that of Alternative B. However, the likelihood of their occurrence is estimated to be roughly four to five times higher for Alternative D than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of these activities on arctic fish populations in Alternative D over that of Alternative B.	First Sale: The effect of fuel spills on arctic fish populations in Alternative E are expected to be similar to Alternative A. The individual effects of seismic surveys, construction related activities, and oil spills are expected to be similar to that of Alternative B. However, the likelihood of their occurrence is estimated to be roughly five to six times higher for Alternative E than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of these activities on arctic fish populations in Alternative E over that of Alternative B.	The additional effect of seismic surveys and construction-related activities over that of Alternative E is expected to be proportional to the number of future activities. Their effect on arctic fish populations may be greater if there is insufficient time for full recovery between these activities. Offshore cumulative-case oil spills are expected to have mostly sublethal effects on arctic fish populations. Those that enter coastal waters are expected to affect a greater percentage of fish than estimated for Alternative E. Assuming sufficient recovery time between spills, the recovery from each cumulative case spill is expected within 3 years. Onshore cumulative-case oil spills are expected to have an effect on arctic fish populations similar to that discussed for Alternative E.
Multiple Sales. Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish as the first sale. Gravel pads are expected to have *about* twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.	**Multiple Sales**. Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish as the first sale. Gravel pads are expected to have *about* twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.	

BIRDS		
Alternative A	**Alternative B**	**Alternative C**
Under Alternative A, most disturbance effects associated with ground transport and seismic surveys in winter, moderate flight frequency supporting large and small camps and aerial surveys, moderate increases of boat traffic on the Colville River, air transport of recreational parties, and spill-cleanup activities in summer, are expected to be localized, to within 700 ft to 0.6 mi of the disturbing activity, and temporary, ranging from brief (<1 day) in the case of response to a few aircraft flights or presence of ground or boat activity to several months for extended ground-transport operations. More intense activity such as routine overflights of goose-molting lakes, the combination of large camp activity and associated aircraft operations, substantially increased river-boat traffic, or fuel spills entering lakes with large molting goose populations, is expected to result in more substantial losses, but recovery of lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available.	**First Sale**: Under Alternative B, most disturbance effects not associated with oil and gas activities are expected to be similar to those discussed for Alternative A, although lost productivity of nesting species and decreased survivorship of molting birds may not be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect of aircraft operations supporting oil and gas activities, and most other activities causing disturbance, on productivity or recruitment of bird populations in the vicinity of drill sites is expected to be localized and minor, but likewise may not be detectable above the natural fluctuations of the population and survey methods/data available. Losses attributed to predators attracted to sites may be substantial but is difficult to quantify. Displacement of nesting birds from gravel structures and pits is expected to have primarily minor local effects on productivity because displaced individuals are likely to use adjacent undisturbed habitats. As a result of their small average size, oil spills reaching aquatic habitats are expected to cause losses of tens of individuals, but the effect of such losses may not be detectable above the natural fluctuations of the population and survey methods/data available.	**First Sale**: Effects of actions other than oil and gas activity under Alternative C are expected to be essentially the same as for Alternative B, except in the Colville River corridor where increased activity would result in greater effects. Effects of oil and gas activity is not expected to be significantly different than discussed for Alternative B.
	Multiple Sales: Displacement of birds from disturbance and habitat alteration is expected to increase in the southern half of the planning area under Alternative B with multiple sales, but not significantly affect coastal plain populations. Increases in oil and refined oil spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect is expected to increase somewhat from that discussed for the first sale.	**Multiple Sales**: Displacement of birds from disturbance and habitat alteration is expected to increase over the southern 3/4 of the planning area under Alternative C with multiple sales, but not significantly affect planning area populations. Increases in oil and refined oil spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect is expected to increase somewhat from that discussed for the first sale.

BIRDS

Alternative D	Alternative E	Cumulative Case
First Sale: Effects of actions other than oil and gas activity under Alternative D are expected to be essentially the same as for Alternative B, except in the Colville River corridor where increased activity would result in substantially greater effects. Effects of oil and gas activity is not expected to be significantly greater than discussed for Alternative B.	**First Sale**:. Effects of actions other than oil and gas activity under Alternative E are expected to be essentially the same as for Alternative B, except in the Goose Molting Habitat LUEA where increased activity would result in substantially greater effects. Effects of routine oil and gas activities is expected to be substantially greater than discussed for Alternative B as a result of offering this LUEA for lease; oil spill effects are not expected to be significantly greater that under Alternative B. A fuel-oil spill is expected to cause mortality in the marine environment if contact with flocks of staging waterfowl occurs.	The overall contribution of proposed activities in the NE NPR-A planning area to the cumulative effects on nonendangered bird populations is expected to be limited primarily to occasional disturbance from aircraft activities, resulting in temporary, nonlethal effects. Disturbance may last less than an hour but could continue several months in the case of drilling operations.
Multiple Sales: Displacement of birds from disturbance and habitat alteration or loss is expected to increase throughout most of the planning area under Alternative D with multiple sales, substantially changing planning area bird population levels and/or distribution. Increases in oil and refined oil spills are expected to result in the loss of numbers of birds than under the first sale, but these losses are not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect is expected to increase substantially from that discussed for the first sale.	**Multiple Sales**: Displacement of birds from disturbance and habitat alteration or loss is expected to increase substantially throughout most of the planning area under Alternative E, but not significantly affect planning area populations. Increases in oil and refined oil spills are expected to result in the loss of substantial numbers of birds, but these losses and recovery of cumulative lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect is expected to increase substantially from that discussed for the first sale.	

TERRESTRIAL MAMMALS		
Alternative A	**Alternative B**	**Alternative C**
The effects of Alternative A on terrestrial mammals are expected to be local, within about 1 to 2 km of activities, and short term, with no significant adverse effects on mammal populations (except the arctic fox, which may increase in abundance near permanent camp facilities).	**First Sale**. For activities other than oil and gas, air traffic, humans on foot, and the presence of resource-inventory-survey camps are expected to increase under Alternative B as compared to Alternative A, but these activities are not expected to affect terrestrial mammal populations. For oil and gas activities, the level of effects due to noise, disturbance, and habitat alteration is expected to increase in the southern half of the planning area. Caribou of the CAH and TLH are expected to be disturbed and their movements delayed along the pipeline during periods of air overflights but these disturbances are not expected to affect migrations and overall distribution. Near oilfield facilities, surface, air, and foot traffic are expected increase under Alternative B and to displace some caribou, moose, muskoxen, grizzly bears, wolfs, and wolverines but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year.	**First Sale**. For activities other than oil and gas, the effects of Alternative C are expected to be similar to those of Alternative A. For oil and gas activities, effects of Alternative C are expected to be somewhat greater than those of Alternative B. Increased habitat alteration would include the development of one or two oilfields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic, but these disturbances are not expected to affect caribou migrations and overall distribution. Near the oilfields, surface, air, and foot traffic are expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase somewhat and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.
	Multiple Sales. The level of effects due to noise, disturbance, and habitat alteration is expected to increase in the southern half of the planning area under Alternative B with multiple sales. Near oilfield facilities, surface, air, and foot traffic are expected increase and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines, but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year.	**Multiple Sales**. Effects of oil and gas activities under multiple sales are expected to be somewhat greater than those of Alternative C under the first sale. Surface, air, and foot traffic near the oilfields is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase somewhat and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.

TERRESTRIAL MAMMALS

Alternative D	Alternative E	Cumulative Case
First Sale: Activities other than oil and gas are expected to increase somewhat under Alternative D a compared to Alternative A, but the increase is not expected to affect terrestrial mammal populations. For oil and gas activities, effects of Alternative D are expected to be significantly greater than those of Alternative B, with more helicopter disturbance of caribou and other terrestrial mammals. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic. Near the oilfields, surface, air, and foot traffic are expected to increase and to displace some terrestrial mammals, but not significantly affect Arctic Slope populations. If a field is developed in the area south and west of Teshekpuk Lake, some TLH caribou calving is expected to be displaced within 1.86 to 2.48 mi (3-4 km) of roads and other production facilities over the life of the project. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 to 2 years.	**First Sale**: Activities other than oil and gas are expected to increase somewhat under Alternative E compared to Alternative A, but the increase is not expected to affect terrestrial-mammal populations. For oil and gas activities, effects of Alternative E are expected to be significantly greater than those of Alternative B, with more helicopter disturbance of caribou and other terrestrial mammals. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic. Near the oil fields, surface, air, and foot traffic are expected to increase significantly and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. If a field is developed in TLH caribou-calving areas, some calving is expected to be displaced within 1.86 to 2.48 mi (3- 4 km) of roads and other production facilities over the life of the project. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.	**Multiple Sales**: The effect of multiple sales under Alternative E is expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.
Multiple Sales: The effect of multiple sales under Alternative D is expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads assumed to be built between production pads south of Teshekpuk Lake. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect-relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude- and fuel-oil spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.	**Multiple Sales**: The effect of multiple sales under Alternative E is expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.	

MARINE MAMMALS		
Alternative A	**Alternative B**	**Alternative C**
The effects of Alternative A on marine mammals, particularly polar bears and seals, along the coast of the planning area are expected to be local and to occur within about 1 mi. of resource inventory-survey activities, survey and recreational camps, and overland moves. These effects are expected to be short term, with no significant adverse effects on the populations as a whole.	**First Sale**: For marine mammals, the effects of activities other than oil and gas under Alternative B are expected to be similar to those under Alternative A—local and short term, with no significant adverse effects to the populations as a whole. The effects of oil and gas activities for Alternative B are expected to increase somewhat over those of Alternative A. However, most oil and gas activities under Alternative B are expected to occur inshore and far to the south of the coast. Only a small increase in potential noise and disturbance effects is expected along the coast, primarily in the Colville River Delta-inner Harrison Bay area, and these effects are expected to be local and short term (generally <1 year).	**First Sale**: For marine mammals under Alternative C, the effects of activities other than oil and gas are expected to be similar to those for Alternative A; the effects of oil and gas activities are expected to be essentially the same as for Alternative B.
	Multiple Sales: Multiple sales under Alternative B are expected to have similar effects to those under Alternative B with one sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.	**Multiple Sales**: Effect of oil and gas activities under Alternative C with multiple sales is expected to be essentially the same as for Alternative B with multiple sales.

MARINE MAMMALS

Alternative D	Alternative E	Cumulative Case
First Sale: For marine mammals, the effects of activities other than oil and gas under Alternative D are expected to be similar to those under Alternative A—local and short term, with no significant adverse effects to the populations as a whole. The effects of oil and gas activities for Alternative D are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects are expected to occur in the Colville River Delta-southern Harrison Bay area.	**First Sale**: For marine mammals, the effects of non-oil and gas activities under Alternative E are expected to be similar to those under Alternative A—local and short term, with no significant adverse effects to the populations as a whole. The effects of oil and gas activities for Alternative E are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance and oil pollution effects is expected to occur along the coast.	Cumulative effects are generally expected to be relatively short term (within <1 generation) on ice seals (ringed, bearded, and spotted seals), walruses, polar bears, and belukha whales and longer term (>1 generation to perhaps several generations) on sea otters and harbor seals. Under Alternative E (with multiple sales and possible NPR-A-wide oil and gas exploration and development), oil resources are estimated to represent 8 percent of the total North Slope production, and production by 2009 could make up 8 to 14 percent (at $18/bbl) of oil carried in tankers in Prince William Sound. As a result, planning-area activities are projected to contribute about 8 percent of the risk of oil-spill mortality and other effects on ice seals, polar bears, walruses, and belukha whales, and 8 to 14 percent of the risk of mortality to sea otters and harbor seals.
Multiple Sales: Multiple sales under Alternative D are expected to have effects similar to those under Alternative D with the first sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.	**Multiple Sales**: Multiple sales under Alternative E are expected to have similar effects to those under Alternative E in the first sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.	

BLANK PAGE

ENDANGERED AND THREATENED SPECIES

Disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

Alternative A	Alternative B	Alternative C
Bowhead whales are not likely to be affected by activities associated with Alternative A. Spectacled and Steller'siders breeding, nesting, or rearing young in coastal habitats or other areas within the planning area may be overflown by aircraft and may experience temporary, nonlethal effects, probably lasting less than an hour. Due to the relatively low density of eiders in the planning area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Eiders affected by activities associated with hazardous- and solid-material removal and remediation may be affected for as long as 4 weeks. Nesting females and their broods may experience temporary, nonlethal effects as a result of these activities. Overall, the effects on spectacled and Steller's eiders exposed to noise-producing activities are expected to be minimal. Such short-term and localized disturbances are not expected to cause significant population effects.	**First Sale**: Bowheads may exhibit temporary avoidance behavior in response to vessel and aircraft activities. In general, bowheads do not appear to travel more than a few kilometers in response to a single disturbance incident and such behavioral changes likely will last only a few minutes after the disturbance has left the area or the whales have passed. Overall, bowhead whales exposed to noise-producing activities most likely would experience temporary, nonlethal effects. The effects of activities other than oil and gas exploration and development on spectacled and Steller's eiders are expected to be the same as Alternative A. The effects of oil and gas activities may be temporary, <1 hour, and nonlethal as in the case of aircraft overflights as noted for Alternative A or longer in the event there is drilling or vehicular traffic during development or production activities in the summer. It is unlikely that the primary Alaskan nesting area of Steller's eiders, located south and southeast of Barrow, would be affected much by these activities, so significant disturbance of nesting or broodrearing eiders is not expected to occur. Most spectacled eider breeding and nesting areas in the planning area are unavailable for oil and gas leasing. Overall, eiders are not expected to be exposed to most noise-producing activities from oil and gas operations and any effects from such exposure likely would be minimal. Improper containment or disposal of refuse at support camps could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks or even adult eiders.	**First Sale**: The potential effects on bowhead whales are expected to be essentially the same as under Alternative B. The potential effects on spectacled and Steller's eiders from to oil and gas exploration and development activities are expected to be essentially the same as under Alternative B. Most spectacled eider breeding and nesting areas in the planning area are unavailable for oil and gas leasing. However, there may be an increase in potential effects on eiders from activities other than oil and gas due to an increase in summertime aircraft flights over sensitive areas that may affect nesting females and their broods.
	Multiple Sales. Effects of multiple sales are expected to be essentially as described above for the first sale. Bowhead whales exposed to noise-producing activities such as marine-vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Spectacled and Steller's eiders are not expected to be exposed to most noise-producing activities from oil and gas operations, and any effects from exposure likely would be minimal. The effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the single sale.	**Multiple Sales**. The effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the first sale.

69

ENDANGERED AND THREATENED SPECIES

Disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

Alternative D	Alternative E	Cumulative Case
First Sale: The potential effects on bowhead whales are expected to be essentially the same as under Alternative B. The potential effects on spectacled and Steller's eiders from oil and gas activities are expected to be essentially the same under this Alternative as under Alternative B. There also may be an increase in potential effects on eiders from activities other than oil and gas due to an increase in summertime aircraft flights over sensitive areas, that may affect nesting females and their broods. Most spectacled eider breeding and nesting areas in the planning area are unavailable for oil and gas leasing.	**First Sale**: The potential effects on bowhead whales are expected to be essentially the same as under Alternative B. The potential effects on spectacled and Steller's eiders from oil and gas activities are expected to be essentially the same under this Alternative as under Alternative B. There also may be an increase in potential effects on eiders from activities other than oil and gas due to an increase in summertime aircraft flights over sensitive areas, that may affect nesting females and their broods.	Exposure of bowhead whales to noise-producing activities from both onshore and offshore oil and gas exploration and development and production operations is not expected to result in lethal effects, but some individuals could experience temporary, nonlethal effects. Prolonged exposure of bowhead whales to spilled oil may result in lethal effects on a few individuals, with the population recovering within 1 to 3 years. Most individuals exposed to spilled oil are expected to experience temporary, nonlethal effects. The overall contribution of proposed activities in the planning area to the cumulative effects on bowhead whales is expected to be limited to temporary avoidance behavior in response to vessel and aircraft activities. Overall, the effects on spectacled and Steller's eiders as a result of various cumulative factors from both onshore and offshore oil and gas exploration and development and production operations is likely to be substantially greater than for any single activity or any activities associated with any individual lease sale. Disturbance of some individuals as a result of both onshore and offshore oil and gas operations is expected to be unavoidable over the long term. Some mortality could result from contact with spilled oil. Cumulative effects are likely to be greater on the Arctic Slope spectacled eider population than on the Arctic Slope Steller's eider population. The overall contribution of proposed activities in the planning area to the cumulative effects on spectacled and Steller's eiders is expected to be limited primarily to occasional disturbance from aircraft activities resulting in temporary, nonlethal effects. Disturbance may last less than an hour but could continue all summer in the case of summer drilling operations. Improper containment or disposal of refuse at support camps could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adult eiders. The overall contribution to the cumulative effects on species along transportation routes from tankering oil produced in the planning area to ports along the U.S. West Coast is expected to be minimal.
Multiple Sales: The effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the first sale.	**Multiple Sales**: The effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the single sale.	

ECONOMY		
Alternative A	**Alternative B**	**Alternative C**
For activities other than oil and gas exploration and development for Alternative A, approximately 50 jobs for 4½ months associated with seismic surveys and recreation employment equivalent to one person working 4 months per year would be generated. For oil and gas exploration and development activities for Alternative A, there would be no economic effects	**First Sale**: For activities other than oil and gas exploration and development for Alternative B, approximately 50 jobs for 4½ months associated with seismic surveys and recreation employment equivalent to one person working 8 months per year would be generated. For oil and gas exploration and development activities, production in Alternative B is projected to generate increases above the levels of Alternative A as follows: NSB property taxes, 0 to 2 percent ($0-$3 million); direct oil-industry employment, 0 to 700 (5x this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 0 to 2 percent; and annual revenues to the State of $0 to $0.75 million, $0 to $4 million, and $0 to $2 million from property tax, royalty income, and severance tax, respectively.	**First Sale**: For activity other than oil and gas for Alternative C, approximately 50 jobs for 4½ months associated with seismic surveys and recreation employment equivalent to one person working 8 months per year would be generated. For activity other than oil and gas would have no effect, production in Alternative C is projected to generate increases above the levels of Alternative B as follows: NSB property taxes, 1 percent ($1-$2 million); direct oil-industry employment, 200 to 500 during production (five times this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 1 percent, and annual revenues to the State of $0.25 to $0.5 million, and $0.5 million from property tax, royalty income, and severance tax, respectively.
	Multiple Sales: The effect of multiple sales for Alternative B is projected to be approximately two times that of Alternative B.	**Multiple Sales**: The effect of multiple sale for Alternative C is project to be approximately two times that of the First Sale for Alternative C.

ECONOMY

Alternative D	Alternative E	Cumulative Case
First Sale: For activities other than oil and gas exploration and development for Alternative D, approximately 50 jobs for 4½ months associated with seismic surveys and recreation employment equivalent to one person working 8 months per year would be generated. For oil and gas exploration and development activities, production in Alternative D is projected to generate increases above the levels of Alternative B as follows. NSB property taxes, 2 percent ($4-$5 million); direct oil-industry employment, 500 (5x this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 1 to 2 percent; and annual revenues to the State of $1 to $1.25 million, $2 to $3 million, and $1 to $1.5 million from property tax, royalty income, and severance tax, respectively.	**First Sale**: For activities other than oil and gas exploration and development for Alternative A, approximately 50 jobs for 4½ months associated with seismic surveys and recreation employment equivalent to one person working 6 months per year would be generated. For oil and gas exploration and development activities for Alternative E, production in Alternative E is projected to generate increases above the levels of Alternative B as follows: NSB property taxes, 3 to 4 percent ($6 to $9 million); direct oil-industry employment, 700 (5 x this in additional jobs) residing in Southcentral Alaska: NSB- resident employment, 2 to 3 percent; and annual revenues to the State of $1.5 to $2.25 million, $2.5 to $6 million, and $1.25 to $3 million from property tax, royalty income, and severance tax, respectively.	Activity other than oil and gas would have no effect on the economy. The cumulative case is projected to generate increases two times those of Alternative E. The effects of the cumulative case above the levels of Alternative E are as follows: NSB property taxes, 3 to 6 percent ($6 to $12 million); direct oil-industry employment, 700 to 1,400 (five times this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 2 to 5 percent; and annual revenues to the State of $1.5 to $3 million, $2.5 to $10 million, and $1.5 to $5 from property tax, royalty income, and severance tax, respectively.
Multiple Sales: The effect of multiple sales for Alternative D is projected to be approximately two times that of the first sale for Alternative D.	**Multiple Sales**: The effect of multiple sales for Alternative E is projected to be approximately two times that of the First Sale for Alternative E.	

CULTURAL RESOURCES

Alternative A	Alternative B	Alternative C
Potential impacts to cultural resources would result from management activities other than oil and gas exploration (except seismic activity) and development. These impacts can be satisfactorily addressed through the current assessment and decisionmaking process.	**First Sale**: Potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to but of an increased magnitude from those of Alternative A. Under Alternative B, most of the potential impacts to cultural resources would result from oil and gas exploration and development.	**First Sale**: Potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature but may be somewhat increased in magnitude over Alternative A. Under Alternative C, most of the to cultural resources would result from oil and gas exploration and development, although there is a possibility that no such activities would impact cultural resources sites. When compared with Alternative B, the potential for impact to cultural resources is somewhat greater under Alternative C.
	Multiple Sales. Potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative A, but the probability of impacts occurring might increase. Under Alternative B, the potential impacts to cultural resources from oil and gas exploration and development would increase dramatically compared to Alternative A, because only seismic activities are permitted under Alternative A.	**Multiple Sales**: Potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under alternative C, the potentioal impacts to cultural resources form oil and gas exsploration and development would increase by rought 20 percent compared to Alternative B.

SUBSISTENCE		
Alternative A	**Alternative B**	**Alternative C**
Impacts on the subsistence resources and the subsistence-harvest patterns of Barrow, Atqasuk, and Nuiqsut from this no-leasing alternative are expected to be negligible	**First Sale**: Overall effects associated with Alternative B subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to periodically impact subsistence resources, but no resource would become unavailable, undesirable for use, or experience overall population reductions.	**First Sale**: Overall effects associated with Alternative C subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase somewhat over Alternative B. Periodic impacts to subsistence resources are expected but no resource would become unavailable, undesirable for use, or experience overall population reductions, essentially the same level of effect as Alternative B.
	Multiple Sales: Effects from multiple sale to terrestrial mammals are expected to increase, but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude-oil and fuel spills, but populations are expected to recover within 1 year. Arctic fish populations would experience effects similar to Alternative B as high-density fish areas are deferred, but increases are expected if sale intervals are not spaced sufficiently to provide population recovery. Increased disturbance and displacement effects and increased oil-spills risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. Bowhead whales are expected to experience short-term, nonlethal effects. Effects to marine mammals would be short term and local with no adverse effects to populations. Given that resource estimates and development scenarios project an increase in resources and large increases in the number of drill pads and pipeline miles, logic would assume increased effects to potentially affected resources, except for the fact that these effects would be spread over 2 decades. The biological analyses expect slight increases in effects with little overall effects to resource populations; therefore, effects associated with multiple sales on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and (especially) Nuiqsut as a result of impacts from disturbance and oil spills are expected to make no subsistence resource unavailable, undesirable for use or experience overall population reductions.	**Multiple Sales**: Effects from multiple sales to terrestrial mammals are expected to increase but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost due to the increase of small chronic crude oil and fuel spills, but populations are expected to recover within 1 year. Arctic fish populations would experience effects similar to Alternative C as high-density fish areas are unavailable to leasing, but increases are expected if sale intervals are not spaced sufficiently to provide population recovery. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. Bowhead whales, as in Alternative C, are expected to experience short-term, nonlethal effects. Effects to marine mammals would be short term and local with no adverse effects to populations. Given that resource estimates and development scenarios project an increase in resources and large increases in the number of drill pads and pipeline miles, logic would assume increased effects to potentially affected resources, except for the fact that these effects would be spread over 2 decades. The biological analyses expect slight increases in effects with little overall effects to resource populations; therefore, effects associated with multiple sales on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and (especially) Nuiqsut as a result of impacts from disturbance and oil spills are expected to make no subsistence resource unavailable, undesirable for use or experience overall population reductions.

SUBSISTENCE		
Alternative D	**Alternative E**	**Cumulative Case**
First Sale: Overall effects associated with Alternative D on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative B. Subsistence resources would be chronically impacted, but no resource would become unavailable, undesirable for use, or experience overall population reductions, resulting in no significant impacts to overall subsistence harvests and harvest patterns.	**First Sale**: Overall effects associated with Alternative E on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative B. Some subsistence resources would be chronically impacted, but still no resource would become unavailable, undesirable for use, or experience overall population reductions. Overall, effects are not expected to have significant impacts on subsistence-harvest patterns in Barrow and Atqasuk, although oil-development activity under Alternative E could make Nuiqsut's pursuit of caribou more difficult for at least an entire harvest season.	Overall cumulative effects to subsistence harvests are expected to cause one or more important subsistence resources to become unavailable, undesirable for use, or experience population reductions for a period of 1 to 5 years in Nuiqsut. In Barrow and Kaktovik, overall cumulative effects to subsistence harvests are expected to cause one or more important subsistence resources to become unavailable, undesirable for use, or experience population reductions for a period of 1 to 2 years. The contribution of the IAP to the cumulative effects in Barrow, Atqasuk, and Nuiqsut would be to affect subsistence resources, especially the subsistence caribou hunt, for up to an entire season (1 year), making their pursuit more difficult (with hunters having to travel farther than normal to harvest them). In all three communities, an oil spill affecting any portion of the bowhead whale migration route may well taint this culturally important subsistence resource, or, even if available, the perception of tainting could substantially affect the desirability of bowheads and curtail the subsistence harvest (see Sec. IV.C.13, Subsistence for a discussion of effects-level definitions).
Multiple Sales: Effects from multiple sales under Alternative D are expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads assumed to be built between production pads south of Teshekpuk Lake. This effect is expected to persist over the life of the oil fields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Based on the assumptions discussed in the text, each additional lease sale is expected to have similar effects on arctic fish as described for Alternative D. However, if there are increased levels of activity associated with future lease sales, and/or insufficient recovery time between sales, greater adverse effects than described for Alternative D are likely to occur. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. Effects to marine mammal populations as a whole from multiple sales under Alternative D are expected to be similar to those under Alternative D with one sale—local and short term, with no significant adverse effects.	**Multiple Sales**: The effect of multiple sales under Alternative E is expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Based on the assumptions discussed in the text, each additional sale is expected to have similar effects on arctic fish as described for Alternative E. However, if there are increased levels of activity associated with future lease sales, and/or insufficient recovery time between sales, greater adverse effects than described for Alternative E are likely to occur. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. Multiple sales under Alternative E are expected to have similar effects to those under Alternative E in the first sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.	

SOCIOCULTURAL SYSTEMS		
Alternative A	**Alternative B**	**Alternative C**
Due to no increase in effects to the sociocultural systems of Barrow, Atqasuk, and Nuiqsut from this no-action alternative, impacts are expected to be negligible.	**First Sale**: Effects from management actions and oil and gas activities in the planning area under Alternative B are unlikely to disrupt sociocultural systems. Disturbance effects would be short term and would not be expected to disrupt or displace institutions and sociocultural systems, community activities and traditional practices for harvesting, sharing, and processing subsistence resources. Overall effects under Alternative B to the sociocultural systems of the communities of Barrow, Atqasuk, and Nuiqsut would be negligible.	**First Sale**: Effects from management actions and oil and gas activities in the planning area under Alternative C are unlikely to disrupt sociocultural systems. Disturbance effects would be short term and would not be expected to disrupt or displace institutions and sociocultural systems, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources. Overall effects under Alternative C to the sociocultural systems of the communities of Barrow, Atqasuk, and Nuiqsut would be negligible, as in Alternative B.
	Multiple Sales: Effects from management actions and oil and gas activities in the planning area for multiple sales under Alternative B could disrupt sociocultural systems for periods up to 1 year, but impacts would not be expected to displace institutions and sociocultural systems, community activities, or traditional practices for harvesting, sharing, and processing subsistence resources.	**Multiple Sales**: Effects from management actions and oil and gas activities in the planning area for multiple sales under Alternative C could disrupt sociocultural systems for periods up to 1 year, but impacts would not be expected to displace institutions and sociocultural systems, community activities, or traditional practices for harvesting, sharing, and processing subsistence resources, the same level of effect anticipated for multiple sales under Alternative B.

SOCIOCULTURAL SYSTEMS

Alternative D	Alternative E	Cumulative Case
First Sale: Effects from management actions and oil and gas activities in the planning area under Alternative D are unlikely to disrupt sociocultural systems. Disturbance effects would be short term and would not be expected to disrupt or displace institutions and sociocultural systems, community activities and traditional practices for harvesting, sharing, and processing subsistence resources. Periodic disruptions to subsistence resources could occur, but any disruptions that could occur from oil and gas activities potentially would be mitigated by BLM inplace stipulations designed to protect caribou, waterfowl, fish, moose, and subsistence resources and harvest practices. Overall effects under Alternative D to the sociocultural systems of the communities of Barrow, Atqasuk, and Nuiqsut would increase over those in Alternative B, but there would continue to be no disruption or displacement of cultural institutions or sociocultural systems.	**First Sale**: Effects from management actions and oil and gas activities in the planning area under Alternative E are unlikely to disrupt sociocultural systems. Disturbance effects would be short term and would not be expected to disrupt or displace institutions and sociocultural systems, community activities and traditional practices for harvesting, sharing, and processing subsistence resources. Periodic disruptions to subsistence resources could occur, but any disruptions that occurred from oil and gas activities potentially would be mitigated by BLM in-place stipulations and mitigation measures designed to protect caribou, waterfowl, fish, moose resources, and specifically subsistence resources, subsistence practices, and hunter access. Overall effects under Alternative E to the sociocultural systems of the communities of Barrow, Atqasuk, and Nuiqsut would increase over those in Alternative B, but there would continue to be no disruption or displacement of cultural institutions or sociocultural systems.	Because of its proximity to most ongoing oil-development activities on the North Slope, cumulative effects on sociocultural systems could cause chronic disruption to the sociocultural systems in the community of Nuiqsut for a period of 2 to 5 years, with a tendency toward the displacement of existing institutions and social organization. Barrow and Atqasuk could experience chronic disruption to sociocultural systems for a period of 1 to 2 years, with no tendency toward displacing existing institutions or social organization. The contribution of the IAP to the cumulative effects would be disturbance effects that could disrupt sociocultural systems for an entire season (1 year) and create disruption to institutions and sociocultural systems, but these disruptions are not expected to displace ongoing sociocultural institutions, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.
Multiple Sales: Effects from management actions and oil and gas activities in the planning area for multiple sales under Alternative D could disrupt sociocultural systems for periods up to 1 year, but impacts would not be expected to displace institutions and sociocultural systems, community activities, or traditional practices for harvesting, sharing, and processing subsistence resources, the same level of effect anticipated for multiple sales under Alternative B.	**Multiple Sales**: Effects from management actions and oil and gas activities in the planning area for multiple sales under Alternative E could disrupt sociocultural systems for periods up to 1 year, but impacts would not be expected to displace institutions and sociocultural systems, community activities, or traditional practices for harvesting, sharing, and processing subsistence resources, the same level of effect anticipated for multiple sales under Alternative B.	

COASTAL ZONE MANAGEMENT

Alternative A	Alternative B	Alternative C
Because leasing, exploration (except for seismic activities), or development activities are not allowed under Alternative A, there are no ground-impacting management actions within the planning area that require coastal consistency reviews by the State.	**First Sale**. For Alternative B, conflicts could occur with specific statewide standards and NSB CMP policies related to potential user conflicts between development activities and access to subsistence resources. Conflicts are possible with the NSB CMP policy related to adverse effects on subsistence resources resulting from periodic disturbance and oil spills, but no resource would become unavailable, undesirable for use, or experience overall population reductions. These effects would occur in the unlikely event of spilled oil contacting subsistence resources and habitats and the activities associated with oil-spill cleanup. No conflicts are anticipated during exploration, since no oil spills are assumed to occur during exploration.	**First Sale**. For Alternative C, the effects of potential conflicts with the State's and Borough's coastal management programs are expected to be about the same as for Alternative B, since no leasing in important caribou and waterfowl areas would occur under Alterative C. Problems could occur with specific Statewide standards and NSB CMP policies related to user conflicts between development activities and access to subsistence resources. Conflicts are possible with the NSB CMP policy related to adverse effects on subsistence resources. These effects could occur as a result of spilled oil contacting subsistence resources and habitats, and the activities associated with oil-spill cleanup. No conflicts are anticipated during exploration.
	Multiple Sales. Displacement of birds from disturbance and habitat alternation is expected with multiple sales, but should not significantly affect coastal plain bird populations. Effects from multiple sales to terrestrial mammals are expected to increase, but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude-oil and fuel spills, but populations are expected to recover within 1 year. Arctic fish populations would experience effects from seismic surveys and pipelines similar to those discussed for the first sale (*i.e.*, no measurable effect on arctic fish populations). However, fuel and oil spills are likely to have a greater effect on fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated for multiple sale. Increased disturbance and displacement effects and increased oil-spills risks are expected to increase for birds in the southern half of the planning area under Alternative B with multiple sales, but not significantly affect coastal plain populations. Bowhead whales exposed to noise-producing activities such as marine-vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Effects of multiple sales and increased potential for noise-producing activities and oil spills to marine mammals would be short term and local with no adverse effects to populations. Multiple sales may cause potential conflicts with the subsistence, habitat, air- and water-quality, and transportation standards of the ACMP, however, each oil and gas lease operating plan will be reviewed for consistency on a case-by-case basis.	**Multiple Sales**. Displacement of birds from disturbance and habitat alternation is expected with multiple sales, but should not significantly affect coastal plain bird populations. Effects from multiple sales to terrestrial mammals are expected to increase, but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude-oil and fuel spills, but populations are expected to recover within 1 year. Arctic fish populations would experience effects from seismic surveys and pipelines similar to those discussed for the first sale (*i.e.*, no measurable effect on arctic fish populations). However, fuel and oil spills are likely to have a greater effect on fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated for multiple sale. Increased disturbance and displacement effects and increased oil-spills risks are expected to increase for birds in the southern half of the planning area under Alternative B with multiple sales, but not significantly affect coastal plain populations. Bowhead whales exposed to noise-producing activities such as marine-vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Effects of multiple sales and increased potential for noise-producing activities and oil spills to marine mammals would be short term and local with no adverse effects to populations. Multiple sales may cause potential conflicts with the subsistence, habitat, air- and water-quality, and transportation standards of the ACMP, however, each oil and gas lease operating plan will be reviewed for consistency on a case-by-case basis.

RECREATION AND VISUAL RESOURCES		
Alternative A	**Alternative B**	**Alternative C**
Impacts to recreation and visual resources from activities other than oil and gas would be minimal and short term, affecting about 1,500 acres. Impacts from ongoing oil and gad activities (seismic surveys) also would be short term, affecting about 500 acres. Several hundred miles of green trails from overland moves and seismic surveys also would be visible during summer months.	**First Sale**: As compared to Alternative A, there would be an increase of approximately 500 acres to 2,000 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. Short-term impacts from ongoing oil and gas exploration activities would impact approximately 9,000 acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would impact about 500 acres. Seismic operations would result in several hundred miles of green trails, possibly *double* those of Alternative A. Oil and gas development would result in the long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 72,000 acres (or 1.6% of the planning area) for the life of production fields and pipelines.	**First Sale**: As compared to Alternative A, there would be an increase of approximately 500 acres to 2,000 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. As compared to Alternative B, short-term impacts from ongoing oil and gas exploration activities would increase from approximately 9,000 acres impacted to approximately 17,500 acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would increase to about 750 acres, a 250-acre increase from Alternative B. Seismic operations would result in several hundred miles of green trails with likely increases over Alternative B directly corresponding to increases in seismic operations. Oil and gas development would result in the long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 82,000 acres (or 1.8% of the planning area) for the life of production fields and pipelines. This is 10,000 acres more than under Alternative B.
	Multiple Sales: Long-term impacts would increase about 40 percent over those of the first sale, ultimately affecting about 90,000 acres or 1.9 percent of the planning area.	**Conclusion—Multiple Sales**: Long-term impacts will accumulate and increase about 45 percent above those of the first sale, ultimately affecting approximately 107,000 acres or about 2.3 percent of the planning area.

SECTION III

DESCRIPTION OF THE AFFECTED ENVIRONMENT

III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. PHYSICAL CHARACTERISTICS:

1. Terrestrial Environment:

a. Geology: The mineral potential, petroleum geology, and oil and gas resource assessment of the Northeast National Petroleum Reserve-Alaska (NPR-A) Planning Area are described below.

(1) Mineral Potential:

(a) Hardrock Mineral Potential: The northeast corner of the NPR-A coastal plain contains no identified hardrock mineral potential. This area was included as part of the Coville Mining District Mineral Assessment study conducted by the U.S. Bureau of Mines during 1991 through 1993 (Meyer, 1995). All of the hardrock mineral potential of the NPR-A occurs south of the Colville River into the northern flank of the Brooks Range and includes the Drenchwater and Story Creek deposits.

(b) Clay Potential: Three deposits of bentonite clay are located in the Umiat quadrangle on the south-southeastern side of the Colville River. Bentonite is used in drilling muds, civil engineering and sealing applications, pet absorbents, and iron ore pelletizing. Due to the proximity of the oil-industry activities along the North Slope of Alaska and northern Canada, the potential for development of these deposits of bentonite clay for drilling muds exists depending upon tonnage and grades of the deposits.

Exploration should be conducted in the southern part of the study area to identify and delineate the extent and quality of the existing deposits and to discern whether any clay deposits occur on the north side of the Colville River with in the study area.

(c) Uranium Potential: Potential uranium deposits may occur along the entire North Slopes of Alaska including the coastal plain area of the NPR-A. Beginning in 1974 the U.S. Department of Energy contracted with Bendix Field Engineering Corporation and the U.S. Geological Survey (USGS) to conduct a sampling program of the entire United States for uranium potential called the National Uranium Resource Evaluation Program (NURE). Sampling occurred during 1976 through 1980 with 668 samples collected in the Harrison Bay quadrangle, 1,144 samples in the Ikpikpuk River quadrangle, 957 in the Teshekpuk quadrangle, and 1,050 samples in the Umiat quadrangle. These samples included sediment and water samples collected from both streams and ponds/lakes (USGS, 1985).

Result of the NURE data show uranium values up to 6,160 parts per billion (ppb) in the Harrison Bay quadrangle, 13,540 ppb in the Ikpikpuk quadrangle, 5,550 ppb in the Teshekpuk quadrangle, and up to 6,210 ppb in the Umiat quadrangle (USGS, 1985).

(d) Coal Potential: Coal in the northeastern NPR-A falls within the eastern extent of the Northern Alaska coal province, the largest coal province in Alaska. This coal province contains the largest coal resource in the entire United States and ranks with the top two or three coal provinces in the world. There are two Cretaceous age coal-bearing formations occurring in the area—the higher quality Chandler Formation of the Nanushuk Group and the younger Prince Creek Formation of the Colville Group (Fig. III.A.1.a(1)-1).

The Early Cretaceous Nanushuk Group extending nearly halfway across the State was formed in a deltaic system deposited in a northeasterly direction. Along the eastern edge of this system, the subbituminous to bituminous Chandler Formation coals outcrop in the bluffs along the Colville River on the southern part of the planning area area. This formation, intertongued with marginal marine to marine rocks, is known to be 1,090 meters (m) thick and thins eastward into beds up to 1.7 m thick. The coal beds have a dip greater than 15 degrees in this portion of the coal province.

The Upper Cretaceous Colville Group deposited in a subsequent deltaic system locally overlies the Nanushuk Group. The Prince Creek Formation is composed of relatively thin seams of subbituminous coal beds most often described as "lignites and bony coals." These coals have not been studied extensively as they have shown a low economic potential. They are best exposed along the banks of the Colville River and its eastern tributaries in the northern part of the planning area.

Coal Resources: The Northern Alaska coal province has an identified resource of 150 billion tons and 4 trillion tons of hypothetical resources (Merritt and Hawley, 1986). The Nanushuk Group contains an estimated hypothetical resource of 848 billion tons to a depth of 1,800 m in the NPR-A. This includes 202.3 billion tons in seams at least 1.5 m hick above a depth of 304 m. Also included is 29.9 billion tons of subbituminous coal and 29.6 billion tons of bituminous coal in seams of at least 30 m thick (Merritt and Hawley, 1986).

If you take one-tenth of the total Northern Alaska coal province resources to represent the area covered by this report, you get reserved of 15 billion tons identified and 400 billion tons of hypothetical resources. More detailed examination of the coal beds within the planning area is needed to determine the economic viability of these coals.

(2) Petroleum Geology: Northern Alaska is an incredibly rich petroleum province, with an estimated in-place endowment of oil and gas equivalent to 77 billion barrels (Bbbl) and proven commercial oil reserves that exceed 17.8 Bbbl. Exploration in northern Alaska has located 32 or more oil and gas fields, but most reserves are located in a few very large oilfields near Prudhoe Bay (Fig. III.A.1.a(2)-1). The key oil source-rock and reservoir sequences present in these commercial oilfields extend across much of the North Slope, including the NPR-A. Because of these geologic trends and the abundance of untested potential traps, northern Alaska and the adjacent continental shelf are considered to hold high potential for new oil and gas fields.

This section describes the past exploration efforts in northern Alaska and discusses key aspects of the geology pertaining to northeastern NPR-A. New stratigraphic play concepts for the Jurassic system, as revealed by the Alpine discovery, may lead to the discovery of fields overlooked by past efforts. Advancements in technology have progressively lowered the field size threshold for commercial development. These factors have prompted a renewed interest in exploration of the NPR-A.

(a) Petroleum Activities in Northern Alaska:

1) Past Exploration Efforts: Petroleum exploration in northern Alaska began in the early 1900's with field parties sponsored by the USGS. Prompted by reports of oil seeps in the Cape Simpson area and concerns about domestic fuel supplies, President Warren Harding established Naval Petroleum Reserve No. 4 (PET-4) in 1923. In 1976, management of PET-4 was transferred from the Navy to the Department of the Interior and renamed the National Petroleum Reserve-Alaska (NPR-A).

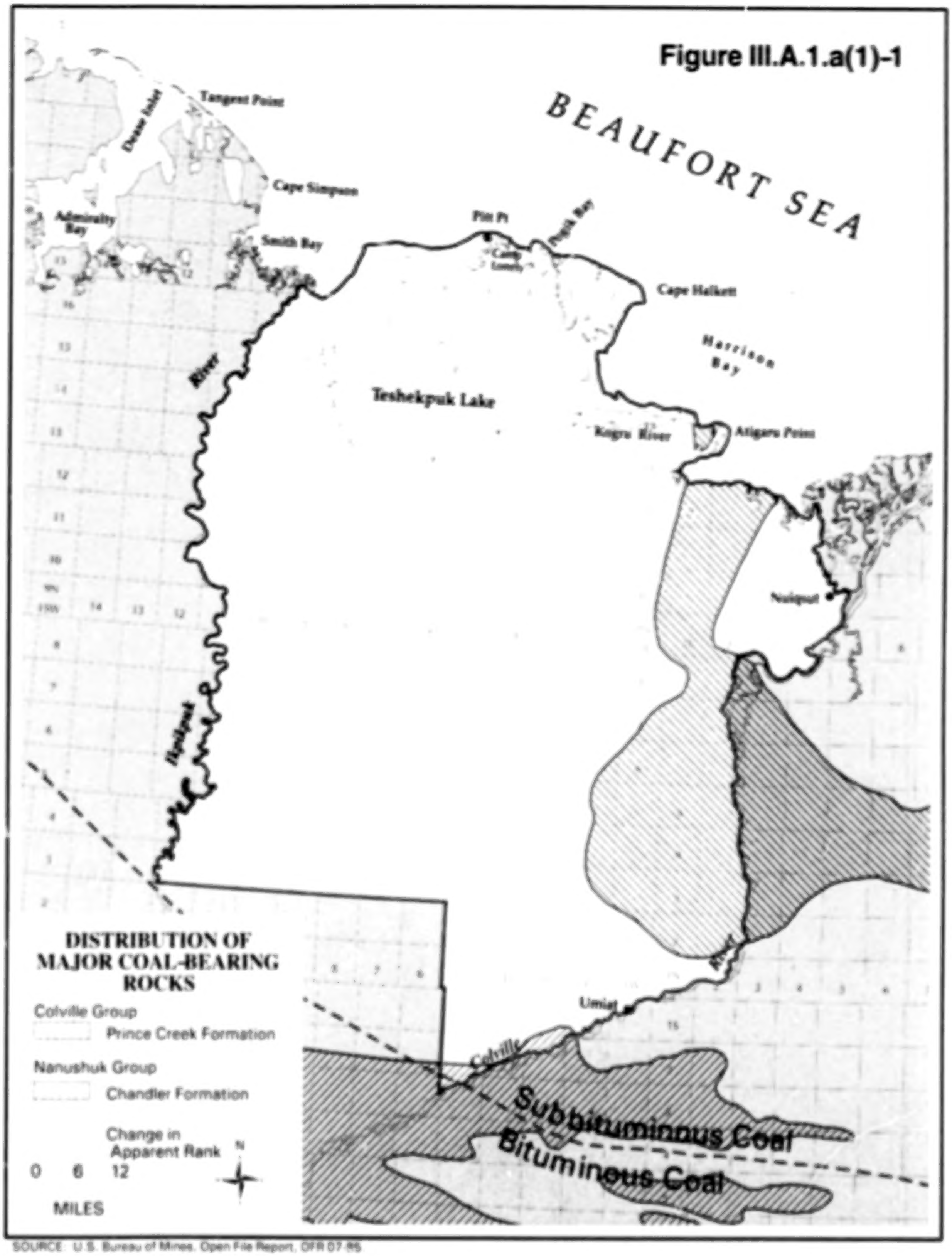
Fuel shortages during World War II prompted the first intensive, government-funded exploration program in the NPR-A conducted by the U.S. Navy from 1944 to 1952. The first exploration wells were drilled near oil seeps and on surface anticlines, resulting in several oil and gas discoveries. Umiat was the first oilfield discovered in northern Alaska (1946), although it remains undeveloped. The South Barrow gas field was the first significant gas discovery (1949) on the North Slope, and it was developed in 1958 by the Federal Government to supply fuel to the village of Barrow.

With Alaska Statehood in 1959, petroleum exploration shifted to State lands selected on the North Slope in the central corridor between the NPR-A on the west and the Arctic National Wildlife Refuge (ANWR) on the east. State lease sales in 1964 and 1965 were followed by the discovery of the super-giant Prudhoe Bay field in 1968. With 12.9 Bbbl of oil, Prudhoe Bay is the largest oilfield ever found in North America. Four other giant oilfields soon were discovered in the vicinity of Prudhoe Bay, including the Kuparuk River field (2.6 Bbbl, 1969), the Milne Point field (270 million barrels [MMbbl], 1970), the Endicott-Duck Island field (600 MMbbl, 1978), and the Point McIntyre field (465 MMbbl, 1988) (State of Alaska, Dept. of Natural Resources [DNR], 1997). Together, these five fields account for 97 percent of oil production from the North Slope of Alaska and nearly 25 percent of all oil production in the U.S. Discovered natural gas resources on the North Slope also are huge, with original proven reserves in the Prudhoe Bay field alone amounting to 26 trillion cubic feet (Tcf).

In response to oil shortages related to the 1973 OPEC embargo, government-sponsored exploration of the NPR-A resumed in 1974 after a two-decade hiatus. The second phase of NPR-A exploration was coordinated by the USGS and resulted in 28 exploration wells (Husky Oil Company) and 14,800 miles (mi) of seismic data (Geophysical Services, Inc.). Numerous oil and gas shows were reported, but no commercial fields were discovered. The legacy of this program is a sizeable assemblage of scientific reports and maps that provide the foundation for ongoing evaluations of petroleum resources in the NPR-A (Gryc, 1988).

To deliver North Slope oil to domestic markets, construction of the Trans-Alaska Pipeline System (TAPS) began in 1974, and the first oil pumped through the pipeline arrived at the ice-free port of Valdez, Alaska in 1977 for tanker shipment. The TAPS throughput peaked at

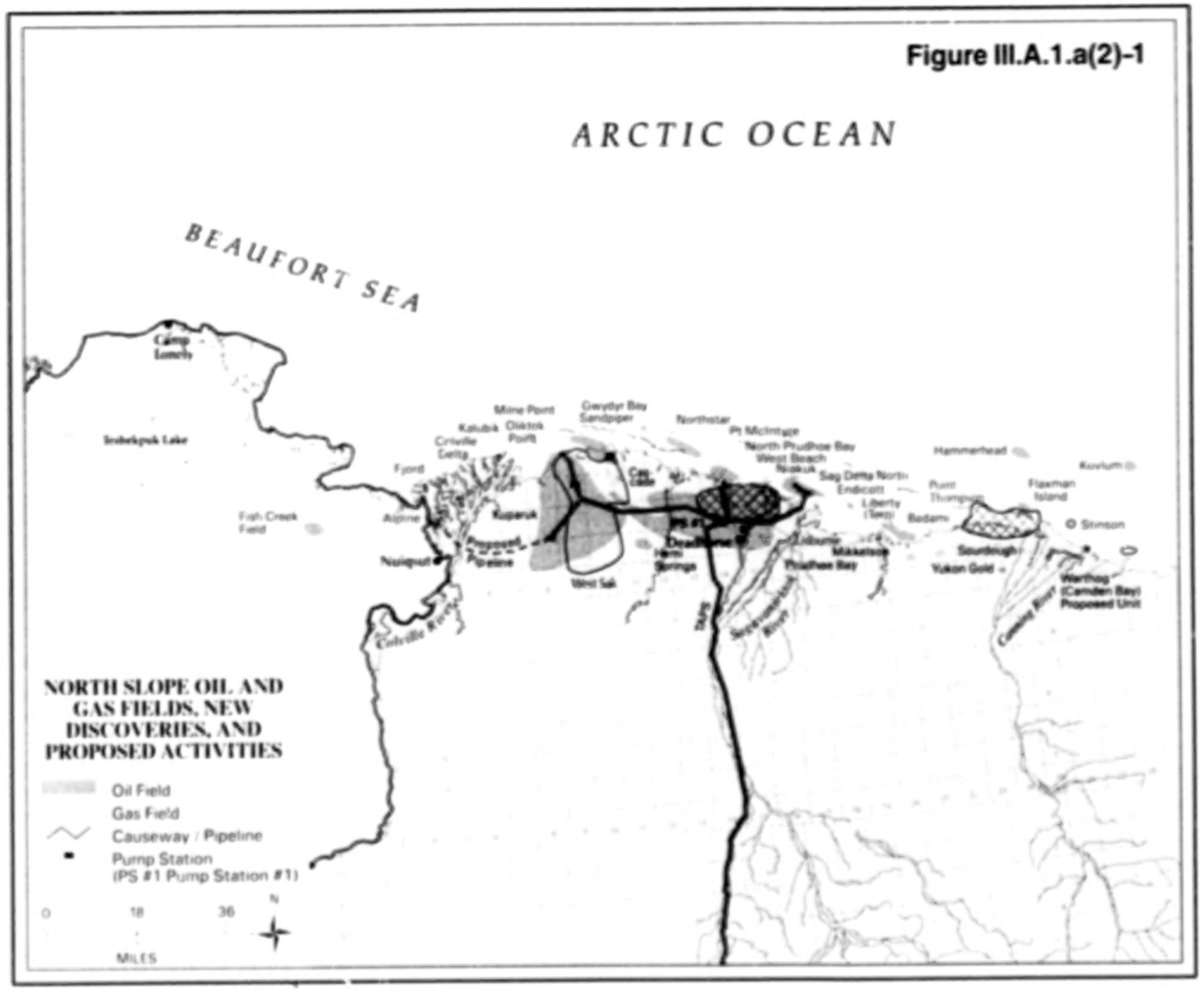
85



SOURCE: U.S. Bureau of Mines, Open File Report, OFR 07-86

BEST COPY AVAILABLE

Figure III.A.1.a(2)-1



BEST COPY AVAILABLE

BLANK PAGE

2.0 million barrels per day (MMbpd) in 1988 and, by mid-1997, production throughput was down to 1.35 MMbpd. In 20 years of production, a total of 11.8 Bbbl has passed through the TAPS.

A recent oil discovery on the Colville delta plays a large role in renewed exploration interest in the NPR-A. The Alpine field was discovered by ARCO and partners in the winter of 1994-1995 (Alaska Report, 1996), and subsequent appraisal drilling has confirmed its reserve potential of 365 MMbbl (Alaska Report, 1997). Alpine is the largest field discovered in Alaska since the discovery of the Point McIntyre field in 1988 and one of the largest fields discovered in the U.S. in recent decades. Of particular significance is that the Alpine discovery has revealed a new geologic play in previously unknown sands in the Jurassic section. The new Jurassic play is likely to extend westward into the NPR-A and will be a principal target for future exploration on the western North Slope (Kornbrath et al., 1997).

2) Leasing and Development:

Petroleum leasing activities began in northern Alaska shortly after Statehood in 1959, and in the years following the 1968 Prudhoe Bay discovery approximately 30 State lease sales have been held on the North Slope. The ongoing State leasing schedule proposes eight future sales between 1998 and 2001 (State of Alaska, DNR, 1995).

A series of Federal lease sales in the NPR-A were held in the early 1980's. The first NPR-A sale (821) was held in January 1982. A total of 1.5 million acres were offered and 653,436 acres were leased (44%) for total high bonus bids of $57.1 million. The second NPR-A sale (822) was held in May 1982. A total of 3.5 million acres were offered and 252,000 acres were leased (7.2%), with total high bonus bids of $9.7 million. The third NPR-A sale (831) was held in July 1983. A total of 2.195 million acres were offered and 419,018 acres were leased (19%), for total high bonus bids of $16.657 million. A fourth NPR-A lease sale (841) was held in July 1984. No industry bids were received for 1.6 million acres offered. A fifth sale (851) scheduled for 1985 was canceled due to legal challenges coupled with an apparent lack of industry interest.

As a result of the NPR-A leasing program, a single well (Brontosaurus, ARCO) was drilled and abandoned as a dry hole in 1985. One other industry well was drilled in 1982 on private in-holdings on Cape Halkett (Livehorse, Chevron), but information from the well remains in confidential status.

The first offshore lease sale in northern Alaska offered nearshore tracts in the vicinity of Prudhoe Bay and was conducted jointly by the State of Alaska and the Federal Government in 1979. This lease sale attracted over $1 billion in high-bonus bids. Since 1979, four additional outer continental shelf (OCS) sales in the Beaufort Sea and two lease sales in the Chukchi Sea have offered most of the OCS off northern Alaska. In all seven offshore sales, a total of 5.5 million acres of Federal lands were leased for total high bonus bids of $4.03 billion. The most recent OCS sale was held in September 1996 (Sale 144) and gathered $14.6 million in high bids on 29 lease blocks in the Beaufort Sea.

As a result of the OCS leasing program, a total of 33 exploratory wells were drilled in Arctic Federal waters between 1980 and 1997 (28 Beaufort Sea wells, 5 Chukchi Sea wells). Nine of these wells are classified by the Minerals Management Service (MMS) as capable of producing in paying quantities (sufficient to pay for operating costs; not necessarily sufficient for commercial development). Four prospects have been unitized for possible development (Northstar, Sandpiper, Hammerhead, and Kuvlum) and a fifth unit at Liberty (Tern) is pending. At present, however, development permits are being obtained for Northstar and Liberty only.

This historical leasing data lends some perspective to the possible scale of activities associated with future NPR-A lease sales. In the previous NPR-A leasing program, a total of nearly 8.8 million acres were offered and 1.3 million acres (roughly 15%) actually were leased. Only one exploratory well was drilled by a private company on leased acreage from three sales. In the OCS, a total of 33 exploration wells were drilled from a lease inventory of 5.5 million acres (averaging 1 well per 31 tracts leased). There has been significantly higher activity levels in adjacent State lands, where it is estimated that approximately half of all the tracts offered have been leased at some time in the more numerous State sales (Kornbrath, 1994). Only a small fraction (about 10%) of the available prospects are ever tested. Historically, the success rate for discovering commercial fields on the North Slope is slightly less than 5 percent. This means that, statistically, only 1 prospect out of 20 prospects tested is likely to become a commercial field. Petroleum exploration in Alaska is clearly a high-risk/high-reward venture.

(b) Geologic History And Stratigraphy:

Northern Alaska and the adjacent continental shelf are underlain by sedimentary rocks that represent approximately 360 million years of geologic time (Fig. III.A.1.a(2)-2). Two thick stratigraphic sequences were deposited in overlapping geologic basins that now lie beneath the present North Slope. The older basin flanked a continental landmass that once lay north of the present Beaufort coastline. The Ellesmerian sequence, deposited in the older basin, contains rock units that grade from proximal (near source terrain) facies in the north to

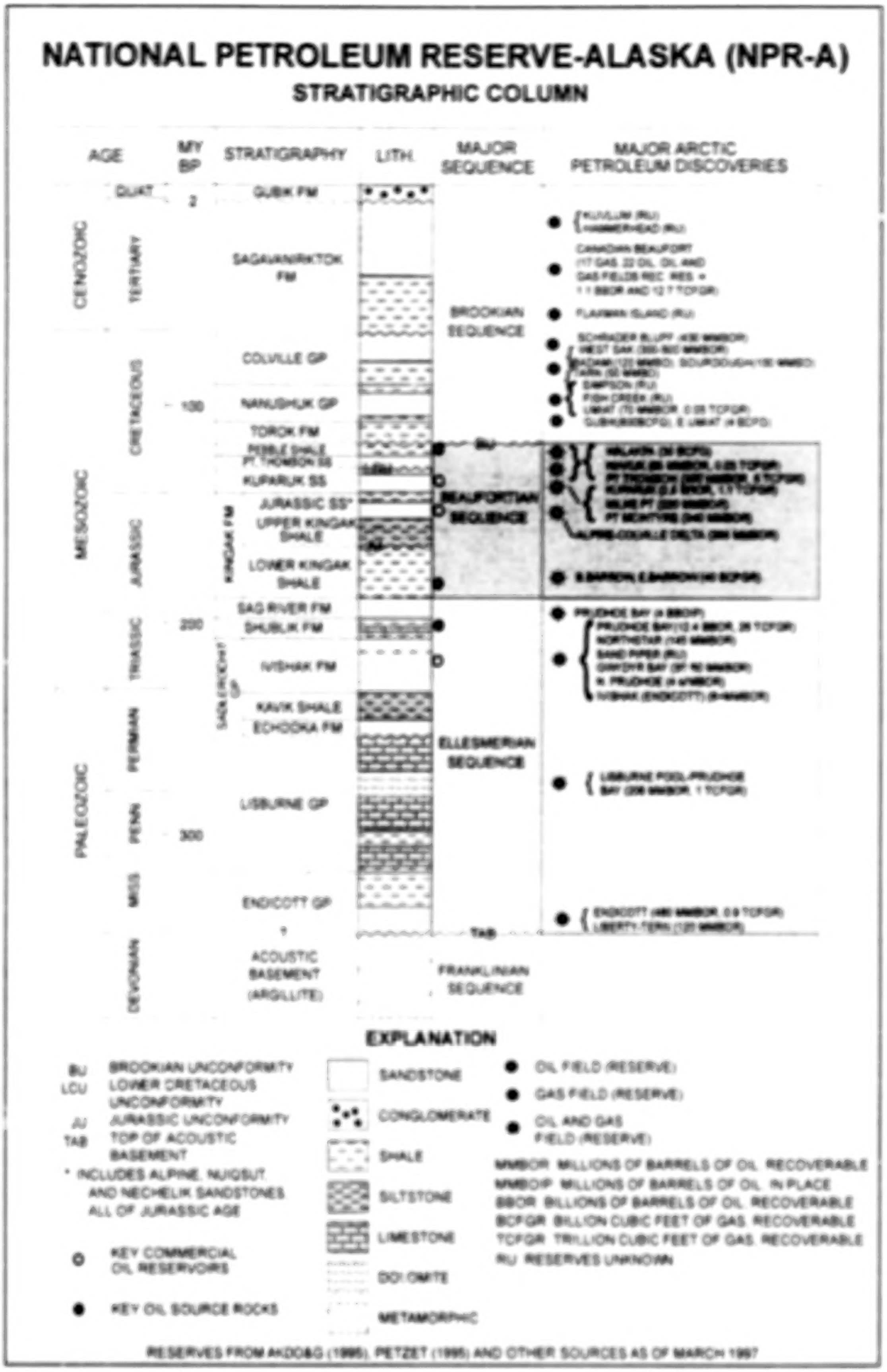


Figure III.A.1.a(2)-2. Stratigraphic column for NPR-A. In addition to formations and lithology, key oil source-rocks and major petroleum discoveries are listed according to their stratigraphic sequence association.

deepwater marine facies in the south. The younger basin was formed as a deep trough (Colville basin) on the north side of a mountain belt whose present expression is the Brooks Range. The Brookian sequence, deposited in the younger basin, contains deltaic and marine deposits shed off the mountain belt into the Colville basin. The transitional period between these two overlapping tectonic events is represented by rocks of the Beaufortian sequence, which were deposited in a low-relief rift zone marking the southern edge of the present Arctic Ocean basin.

The primary structural features in northern Alaska are shown in Figure III.A.1.a(2)-3. Of particular importance to later discussions of petroleum potential are the Brooks Range, Colville Basin, and Barrow Arch (progressing south to north). Numerous literature references describe the stratigraphy and tectonic evolution of northern Alaska and its adjacent continental margins. For additional information, readers should refer to these general references: Brosge and Tailleur (1971); Grantz and May (1982); Craig, Sherwood, and Johnson (1985); Hubbard, Edrich, and Rattey (1987); and Moore et al. (1994).

1) **Franklinian Sequence**: In many areas throughout the Arctic, sedimentary rocks rest unconformably upon a highly deformed, low-grade metamorphic complex of Precambrian to early Paleozoic age. In northern Alaska and northern Canada, these metamorphic rocks were formed from sedimentary rocks assigned to the Franklinian sequence. Franklinian rocks are less deformed (and not metamorphic) in northern Canada where they host oil and gas deposits (Stuart, Smith, and Wennekers, 1977). In Alaska, Franklinian rocks are generally considered to be economic basement, although oil and gas shows are reported in the Point Thomson area.

2) **Ellesmerian Sequence**: The Ellesmerian sequence in northern Alaska ranges broadly in age from mid-Paleozoic to mid-Mesozoic (Fig. III.A.1.a(2)-2). These sedimentary rocks were once part of a continuous "supercontinent" that extended across wide areas of the present Arctic (Jackson and Gunnarsson, 1990; Embry, 1990). This supercontinent was fragmented in early Cretaceous time during initial rifting of the Arctic oceanic basin (Grantz and May, 1982). Now, correlative rocks are found on several circum-Arctic continents ranging from eastern Siberia (Chukotka) to near Greenland (Canadian High Arctic). The rocks that record the prebreakup basin in northern Alaska are grouped under the name "Ellesmerian sequence" because of their similarity to rocks of the same age exposed on Ellesmere Island in northern Canada (Lerand, 1973). The Ellesmerian sequence contains several productive reservoirs, including Kekiktuk (Mississippian, Endicott group) in the Endicott/Duck Island and Liberty/Tern Island fields; Lisburne (Mississippian-Pennsylvanian, Lisburne group); and Ivishak (Permian-Triassic, Sadlerochit group) in the Prudhoe Bay and Northstar fields (Fig. III.A.1.a(2)-2).

3) **Beaufortian Sequence**: The breakup period of the old supercontinent and associated Ellesmerian rocks is represented by marine sedimentary rocks ranging in age from Middle Jurassic to Early Cretaceous (175-115 million years ago [Ma]) (Fig. III.A.1.a(2)-2). These strata are referred to as the Beaufortian sequence, a name applied by Hubbard, Edrich, and Rattey (1987) to rift zone deposits along the Beaufort Sea continental margin. The Beaufortian sequence contains rocks correlative to reservoirs in five major commercial fields on the North Slope, including the Kuparuk, Point McIntyre, Alpine, Milne Point, and Niakuk fields.

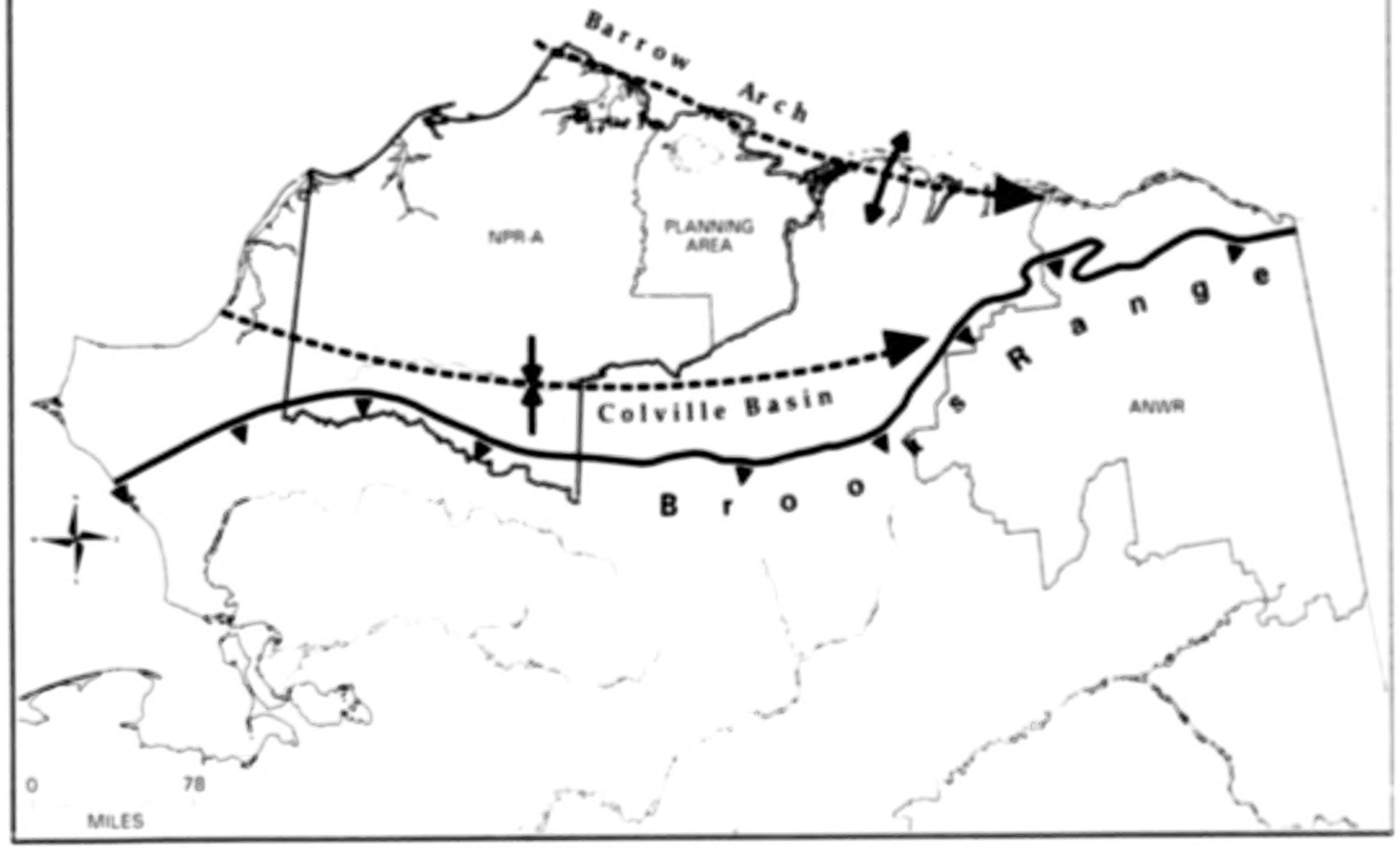
4) **Brookian Sequence**: With continental breakup as a result of seafloor spreading in the Arctic oceanic basin, crustal movements caused collisions along plate margins between fragments of the original continent and outlying continental masses. These collisions caused uplift of new mountain belts and complementary foreland sedimentary basins (Bird and Molenaar, 1992). The actively subsiding basins flanking the mountain belts received clastic debris eroded from the adjacent mountains. In northern Alaska, the rocks that record this collision event are termed the "Brookian" sequence, in deference to their association with the Brooks Range. Rocks correlative to the Brookian sequence of Alaska are found on all of the circum-Arctic continents but can be quite varied owing to their independent source terrains and basin types. Brookian rocks in northern Alaska are nonmarine, deltaic, and deep-marine strata ranging in age from Early Cretaceous (about 115 Ma) to the present (Fig. III.A.1.a(2)-2). To date, Brookian reservoirs have not contributed significantly to North Slope production. However, numerous marginally commercial discoveries are in early phases of production or planned production, including West Sak/Kuparuk, Schader Bluff/Milne Point, and Badami.

(c) **Petroleum Potential**: The TAPS currently is shipping nearly 500 Mmbbl of oil annually from fields on the North Slope to outside markets. Most of this oil (80%) is produced from reservoirs in the Ellesmerian sequence. Fields in the Beaufortian sequence account for slightly less than (<) 20 percent of North Slope production. At present, Brookian sequence reservoirs contributed <1 percent of the total TAPS throughput, although this proportion is expected to increase in the future with new development activities at West Sak, Milne Point, Tarn, Badami, and other Cretaceous-age fields.

The reason that most oil production has been associated with Ellesmerian reservoirs is due largely to exceptional reservoir qualities in Sadlerochit (Ivishak formation) and

Figure III.A.1.a(2)-3

MAJOR TECTONIC FEATURES OF
NORTHERN ALASKA



BEST COPY AVAILABLE

91

CROSS SECTION FROM BROOKS RANGE TO BEAUFORT SHELF

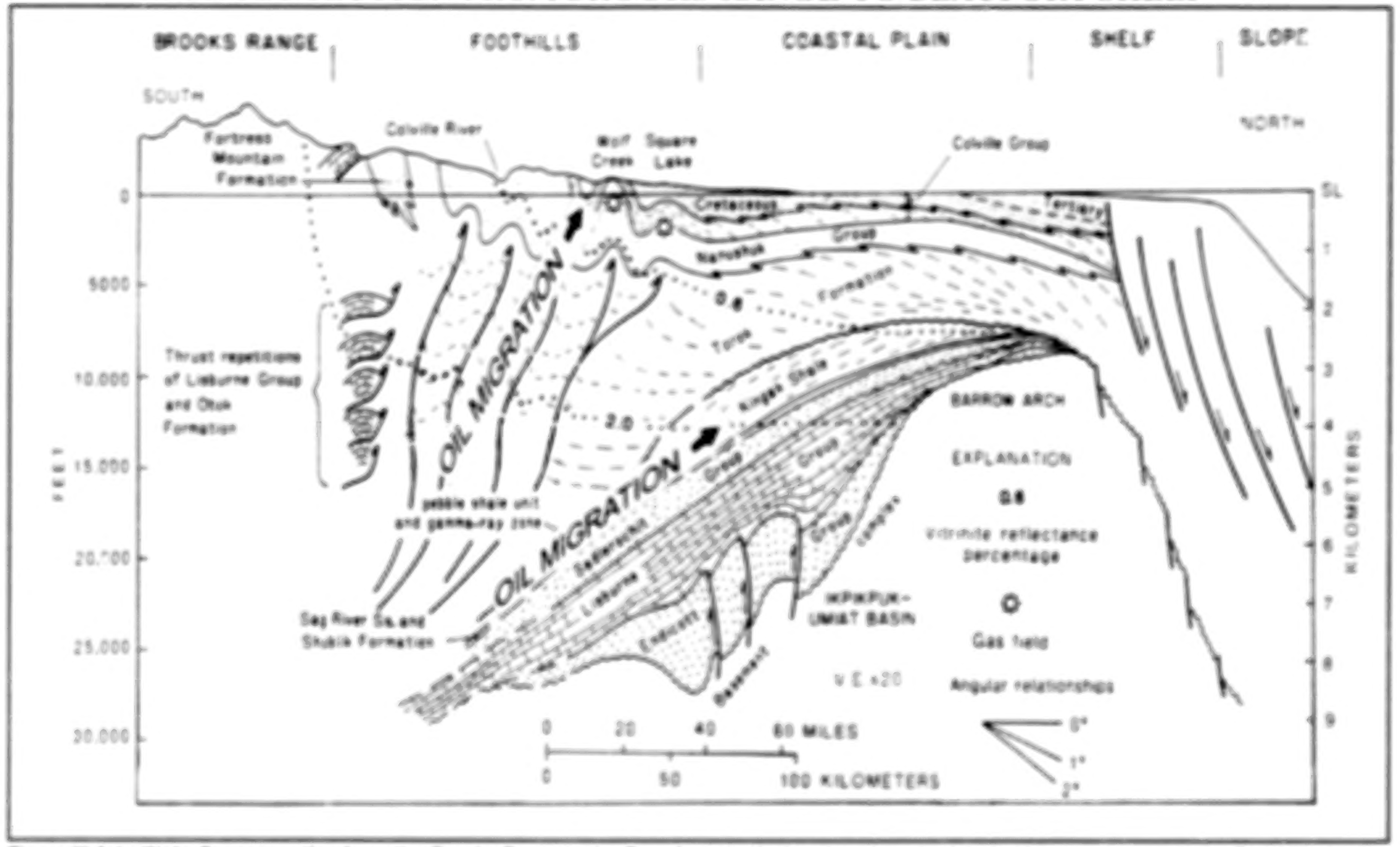


Figure III.A.1.a(2)-4. Cross section from the Brooks Range to the Beaufort shelf, showing deep burial of older strata beneath the Foothills area of the Colville basin. Eight trillion barrels of oil generated from Ellesmerian and Beaufortian source-rock sequences have migrated north toward higher structural areas along the Barrow Arch. Figure is modified from Bird and Molenaar, 1992.

Endicott (Kekiktuk formation) sandstones that occur in this sequence (Fig. III.A.1.a(2)-2). Because of their proven performance as commercial petroleum reservoirs, Ellesmerian prospects traditionally have been the chief exploration objectives in northern Alaska. Reservoir qualities comparable to the Ellesmerian reservoirs are rarely found in the younger Beaufortian and Brookian sequences. These younger reservoirs are typically thinner, more laterally discontinuous, and have lower performance characteristics. Accordingly, these sequences have been viewed as secondary objectives.

1) The Ellesmerian! Petroleum System: The geologic events that created the giant oil fields in northern Alaska are fairly straightforward. During several intervals between Triassic and Early Cretaceous time (230 to 115 Ma), fine-grained marine sediments rich in organic matter were deposited across northern Alaska. Uplift and northward thrusting of the ancestral Brooks Range through Cretaceous time loaded the crust and formed a deep foreland trough (the Colville basin) that was filled with over 20,000 feet (ft) of deltaic and marine sediment. These younger strata were piled on top of the older organic-rich shales and, by mid-Cretaceous (about 100 Ma), the source-rocks had reached burial depths and temperatures where organic matter was converted to oil. The oil was expelled into porous carrier beds and migrated northward toward a compensating structural ridge called the Barrow arch which trends northwest-southeast along the present coastline (Fig. III.A.1.a(2)-4). A portion of this oil was ultimately trapped to form fields along the Barrow arch trend, such as Prudhoe Bay.

Organic-rich shales and limestones within the Ellesmerian and Beaufortian sequences are the sources for 98 percent of the oil endowment of northern Alaska (Bird, 1994). Bird (1994) has termed this oil generation, migration, and entrapment system the "Ellesmerian! petroleum system" and estimates its total generative potential at 8 trillion barrels (bbl) of oil. Only about 1 percent (70 Bbbl) of the total oil generated by the Ellesmerian petroleum system is presently accounted for (as in-place oil) in northern Alaska (Bird, 1994). In the NPR-A, other petroleum- generating systems associated with Cretaceous deposits in Colville basin probably generated the various oil types found at Umiat and Simpson, and the gas found at Wolf Creek, Square Lake, and Gubik (Magoon and Claypool, 1988). The ability of these petroleum systems to generate oil and gas far exceeds the capacity of accessible traps. These prolific oil-generation and trap- charging systems are among the chief attractions to petroleum exploration in northern Alaska.

2) Future Petroleum Exploration Trends: Although the Ellesmerian sequence has a strong tradition of exploration success both onshore and offshore, it is an interesting historical note that the most spectacular failure in the history of petroleum exploration in Alaska was also an Ellesmerian test. The Mukluk prospect initially was thought to contain from 1.5 to 10 Bbbl of recoverable oil. It was leased in 1982 for total high bids exceeding $1.5 billion, with the highest single bid of $227 million for one OCS tract (nearly $40,000/acre). The Mukluk well was drilled in 1983 at a cost of $120 million and then plugged and abandoned as a dry hole. It remains to this day the most expensive dry hole ever drilled.

The failure at Mukluk marked a turning point in the oil industry's previously unbridled enthusiasm for northern Alaska, coinciding with early signs of the coming collapse in oil prices in the mid-1980's. Prior to the Mukluk experience, many industry explorers felt that another field the size of Prudhoe Bay must occur on the North Slope. Mukluk proved how risky that notion could be and presaged a decade-long crash in exploration work in Alaska.

With passing time and improving financial conditions, industry's interest in exploring northern Alaska has begun to rebound. Although few geologists genuinely expect to find more Prudhoe Bay-sized fields in northern Alaska, many see a high potential for undiscovered fields of more modest sizes. Today, oilfields of 100 to 200 MMbbl are planned for new development, and satellite fields (that share existing infrastructure) of only 30 to 50 MMbbl are seriously considered. With the minimum commercial field thresholds lowered to these levels, due in large part to technological advances in drilling and reservoir development, there is a widespread opinion that abundant exploration opportunities are present throughout northern Alaska. This perception likely will encourage exploration for decades to come.

Industry strategy also has shifted somewhat from exploring completely untested (wildcat) geologic plays in remote areas to detailed re-examination of proven plays in areas near existing infrastructure. This strategy is based on two main assumptions: exploration that focuses on proven plays is more likely to be successful; and the economics for development are more favorable if existing infrastructure is utilized. Consequently, new development is likely to expand incrementally from existing North Slope infrastructure rather than as widely scattered startup projects.

The Alpine field clearly is a key factor in the resurgence of industry interest in the NPR-A. The Jurassic reservoirs constitute a new exploration play (announced in October 1996) that is likely to extend over the northern third of the planning area (Kornbrath et al., 1997). Although the reservoirs are of modest thickness (averaging 50 ft), new technology will allow the economic recovery of 365

MMbbl of the total estimated in-place volume of 800 to 1,000 MMbbl at Alpine. New Alpine facilities in the Colville delta, and the sales-oil pipeline under the Colville River connected to the Kuparuk River unit, will establish infrastructure on the eastern border of the NPR-A. New design concepts could provide the template for future fields in other environmentally sensitive areas in northern Alaska. The new Alpine infrastructure (processing/support facilities and pipeline) will undoubtedly fit into plans for future developments of commercial discoveries in the northern NPR-A. It is quite likely that fields similar in size and stratigraphy to Alpine could have been overlooked by previous exploration efforts in the NPR-A or, if discovered, would have been considered as subeconomic only a decade ago.

The previous discussion has briefly described the long and complex geologic history of Alaska's North Slope. The tectonics and associated stratigraphic sequences have combined to create a diverse and highly successful commercial petroleum province. Seismic mapping and well data have established that many of the key reservoir and source-rocks that formed the present commercial fields also occur beneath the NPR-A. The following subsection presents the results of a recently completed resource assessment of the undiscovered hydrocarbon potential in the planning area.

(3) Oil and Gas Resource Assessment:

(a) Purpose of Assessment: Estimates of undiscovered oil and gas resources provide the basis for identifying high-potential areas for leasing and evaluating possible environmental effects associated with future petroleum development. The consequences of a leasing program, including both economic benefits and environmental impacts, are based on commercial hydrocarbon volumes likely to be leased, discovered, and produced from the area under consideration. Prior to environmental analysis, the geology and engineering characteristics of the area are studied, new information is compiled, and past resource assessments are reviewed. Computer simulation models are then employed to generate statistical estimates of hydrocarbon resource potential. The activity scenarios associated with future petroleum development are based on the estimates of economic resource potential.

(b) Resource Modeling: Estimating undiscovered resources is a difficult and somewhat subjective process because of many inherent uncertainties. The size, number, and location of possible fields are interpreted using seismic data to identify subsurface features that could form hydrocarbon traps. The characteristics of potential reservoirs, source-rocks, and seals are inferred from analyses of well logs. Analogs from similar geologic settings can be applied to untested areas with little or no data. A fundamental problem is that the presence of petroleum accumulations cannot be verified without exploration drilling. The actual volume of reserves produced from developed fields cannot be accurately known until the field is entirely depleted and abandoned, many decades after its discovery. To acknowledge these uncertainties, resource estimates are typically reported as ranges of volume with associated probabilities, rather than single numbers. For single number estimates, usually the average (or mean) value of the distribution is reported.

Two general categories of hydrocarbon resources are evaluated in the present assessment:

- *Conventionally recoverable resource potential* includes pooled oil and gas accumulations recoverable by current technology without regard to economic viability.
- *Economically recoverable resource potential* includes pools that could be developed and produced profitably under a given set of engineering and economic assumptions.

For this assessment, both undiscovered resources and discovered oil and gas accumulations are combined into the conventionally recoverable resource potential. None of the discoveries in the NPR-A (for example, the Umiat oilfield) are commercial at present, most have uncertain resource volumes, and all are available for future leasing. Under these circumstances, resource potential equates to all available oil and gas accumulations, whether undiscovered or discovered and not fully appraised.

Although the conventionally recoverable potential represents the total oil and gas estimated to occur in the area, the environmental impacts associated with future activities are based on the economic resource potential. It is conceivable that future technological advancements or progressive lowering of development costs through experience could increase the fraction of economically recoverable resources. However, the effects of future technology is not directly modeled.

Two computer models, developed by MMS for offshore resource assessments, were used in evaluating the planning area. Descriptions of how these computer models were developed and used in the recently completed 1995 National Resource Assessment are given in USDOI, MMS (1996d) and Sherwood, Craig, and Cooke (1996). The application of these two computer programs is summarized here.

The *Geologic Resource Assessment Program (GRASP)* is used to calculate the conventionally recoverable resource potential (also referred to as the "geologic potential"). Geologic characteristics of reservoirs and play groups are input as ranged variables, which are sampled randomly to determine pool numbers and size. The primary output products include cumulative frequency (probability) distributions for total oil, gas, and BOE (barrels of oil equivalent) volumes, in addition to a pool rank (size) distribution for each geologic play assessed. The pool rank distribution shows the number of accumulations expected and their sizes ranked from largest to smallest. These data represent the hydrocarbon pools expected to be present in the assessment area.

The *Probabilistic Resource Estimates-Offshore (PRESTO)* model conducts a discounted cash flow simulation for the development and production of each pool. In a given trial, pools that have positive net present value are deemed to be commercially viable and therefore contribute to the total economic potential of the area. The economic analysis proceeds as a series of simulation runs at different commodity prices, and the results are displayed in Price-Supply curves. As expected, higher commodity prices will increase the resource volumes that are profitable to produce. At very high (perhaps unrealistic) prices, the economically recoverable resource approaches the conventionally recoverable volume calculated previously by the GRASP model.

(c) Geologic Assessment: It is important to acknowledge that resource assessments are built on a constantly changing database, and most should, therefore, be viewed as updates of previous work. Such is the case for the present MMS Bureau of Land Management (BLM) assessment. Numerous oil and gas resource assessments have been conducted previously in the NPR-A (Bird and Powers, 1988), the most recent of which was completed in 1995 by the USGS as part of the National Resource Assessment (Bird, 1995; Attanasi and Bird, 1995). However, the previous assessments did not provide resource estimates specifically for the planning area. We felt that there was a need to provide a more detailed assessment of this specific area for use in planning for future leasing, in addition to updating the resource estimates by incorporating recent geologic information. The present petroleum resource assessment was completed in April 1997 by MMS and BLM. Additional mapping and prospect evaluation is ongoing in preparation for a possible lease sale in late 1998.

The overall assessment is organized around fundamental units called *geologic plays*. A play is a unique group of prospects having common attributes of trapping mechanism, reservoir stratigraphy, and hydrocarbon source. Prospects are untested traps which could contain hydrocarbons. A fraction of these prospects is expected to be actual pools containing oil and gas, but most of the prospects are likely to be dry (devoid of recoverable hydrocarbons). The fraction of pools within the play is determined subjectively by risking the likelihood that all of the key elements (trap, reservoir, and source) occur simultaneously to form an accumulation. Geologic play assessment methodology is commonly used in frontier areas with limited production history. Using this play approach, general information about the geology of an area can be converted into estimates of resource potential.

1) Play Definitions: The basic approach to defining geologic plays was to review recent USGS and MMS assessments of correlative or analog plays in northern Alaska and determine the corresponding plays expected in the planning area. The USGS work for onshore areas of northern Alaska is discussed in Bird (1988a, 1995). Offshore assessment work by MMS completed for the adjacent Beaufort and Chukchi shelf areas is summarized in Sherwood (1996). The MMS and BLM geologists collectively integrated new play concepts (Alpine discovery) with previous assessments to generate the geologic input for the present assessment of the study area.

Geologic plays in the area were identified primarily on the basis of stratigraphy, as is the common practice. For example, we recognized Beaufortian and Brookian plays containing potential reservoirs within the major stratigraphic sequences (Fig. III.A.1.a(2)-2). The Ellesmerian sequence was divided into several plays according to proven (producing) reservoir formations. Our play definitions are more specific than the 1995 USGS assessment (Bird, 1995), which tended to combine formations into more generalized play groups. Consequently, the 1997 MMS BLM assessment evaluated 14 plays as opposed to the 7 plays assessed by the USGS.

Further play groupings were based on likely hydrocarbon occurrences (gas-only versus mixed oil gas-bearing rocks). Hydrocarbon occurrence is largely controlled by subsurface reservoir temperature and depth. Prospective reservoir rocks that underlie the NPR-A occur in burial depths ranging from < 2,000 ft in the north to depths exceeding 30,000 ft to the south beneath Colville basin (Fig. III.A.1.a(2)-4). Rocks at temperatures greater than (>) 400 °F normally contain only gas, because organic source material and petroleum liquids have been transformed by thermal reactions into a gas phase. The base of the oil window corresponds to a thermal maturity value measured by vitrinite reflectance (organic alteration index) of 2.0 (labeled as a dotted line in Fig. III.A.1.a(2)-4). Based on the thermal maturity of reservoir formations, "gas-only" plays in the southern parts of the assessment area were treated separately from mixed oil and gas plays present in the north.

95

Play groupings were also based on the proximity to the Barrow arch, the prominent subsurface structural ridge that generally parallels the coastline of northern Alaska (Fig. III.A.1.a(2)-3). Ellesmerian and Beaufortian rocks above this ridge were deposited in a more proximal setting (closer to source terrane) and are expected to be coarser grained compared to distal sediments deposited to the south. Perhaps important as reservoir lithology, the Barrow arch served as a regional focal point for hydrocarbons migrating from the Colville basin (Fig. III.A.1.a(2)-4). We adopted the same southern boundary of the Barrow arch plays as the USGS in their 1995 assessment. The areas between the Barrow arch plays to the north and the gas-only plays to the south contain what we call the Arctic Platform plays, which offer a mix of oil and gas resources.

In the Brookian sequence, depositional setting also forms a basis for play definition. For example, potential reservoirs in the Brookian sequence occur in two highly dissimilar depositional settings. In the lower part of the sequence, turbidite sandstones were deposited in deep marine environments. In the upper part of the sequence, fluvial to shallow marine sandstones were deposited near delta shorelines (Molenaar, 1988). These different depositional environments typically produce quite different reservoirs characteristics (thickness, lateral continuity, potential storage volumes).

2) Play Descriptions: Using the above criteria, 14 individual geologic plays are recognized within the study area.

Play 1: Endicott-Barrow Arch. Play 1 covers 485 square miles (mi^2) and lies at depths ranging from 6,000 to 12,000 ft within the planning area (Fig. III.A.1.a(3)-1). The reservoir objectives are Endicott Group (Mississippian) sandstones deposited in fluvial to shallow-marine settings. Deposition of these strata filled structural depressions on the faulted erosional surface above Franklinian basement rock. Endicott reservoirs are likely to be thin or absent from some local structural highs within the play area (Fish Creek platform; Molenaar, Bird, and Collett, 1986). Common trap types are wedges of Endicott sandstones flanking local basement highs, with combination low-side fault and stratigraphic traps. Petroleum charging was probably from the Ellesmerian petroleum system.

Play 2: Endicott-Arctic Platform. Play 2 covers 985 mi^2 and lies at depths between 8,000 and 14,000 ft within the planning area (Fig. III.A.1.a(3)-1). The reservoir objectives involve Endicott Group (Mississippian) sandstones. Play 2 has a history of deeper burial than the correlative strata in play 1, with probable negative effects on porosity and hydrocarbon yield factors. The play contains subtle stratigraphic traps in the southern part of the play area along sub-basin flexures. Because of deeper burial and difficult access to known oil source-rocks, hydrocarbons were probably derived from gas-prone shales within the lower Ellesmerian sequence. Play 2, therefore, is likely to contain higher proportions of gas than its northern correlative play.

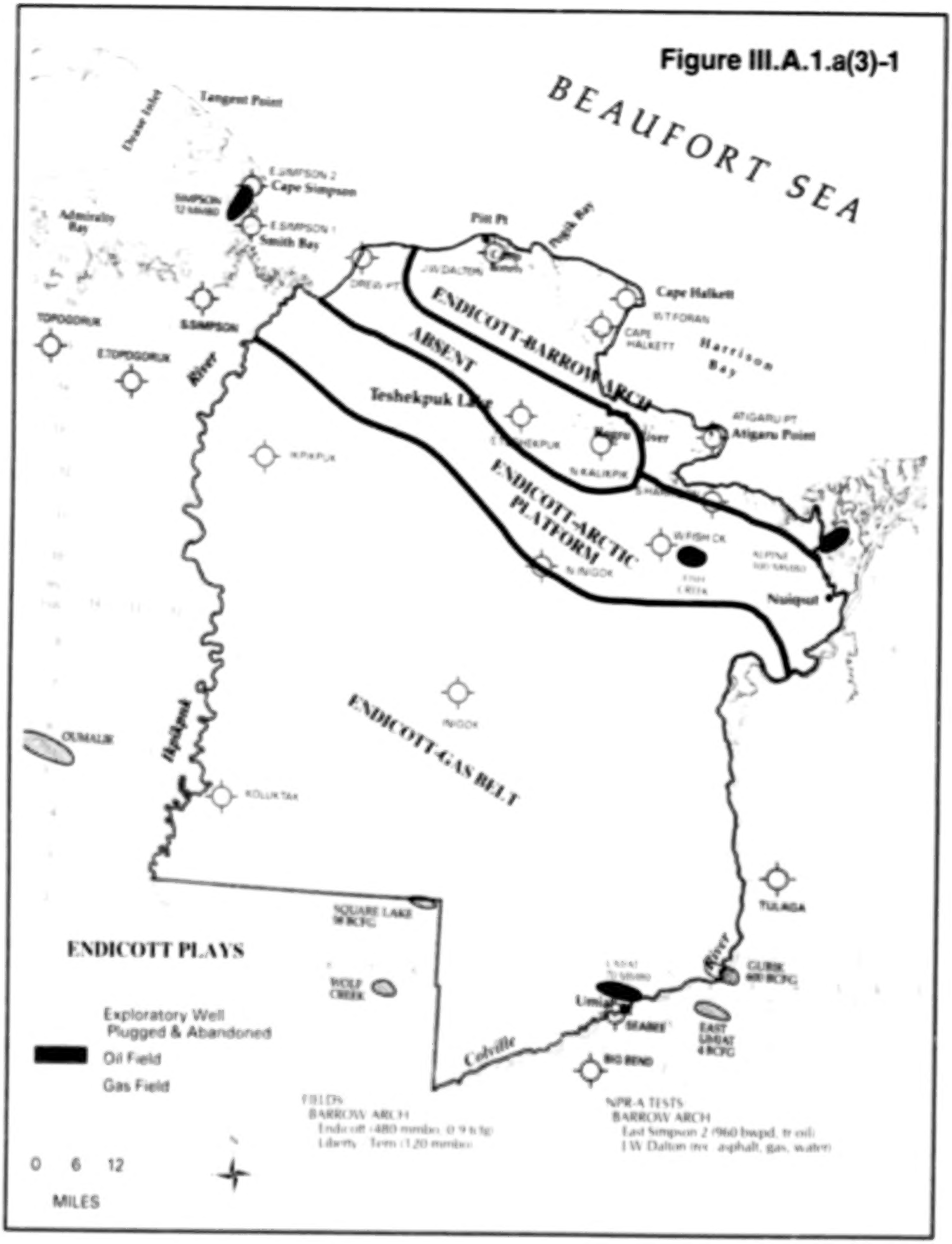
Play 3: Ellesmerian-Gas Belt. Play 3 covers 5,033 mi^2 at maximum and lies at depths ranging from 12,000 to 32,000 ft within the planning area (Figs. III.A.1.a(3)-1, -2, -3). It includes all of the Ellesmerian sequence reservoirs (Endicott, Lisburne, and Sadlerochit) where they are buried so deeply that natural gas is the prevailing hydrocarbon type. Potential traps include stratigraphic traps, and thrust-fault structures associated with Brooks Range thrust sheets. Because of deep burial, reservoir porosity and yield factors are expected to be greatly reduced. Hydrocarbon sources are from the Ellesmerian sequence, but all trapped hydrocarbons have been altered to natural gas as a result of extreme temperature.

Play 4: Lisburne-Barrow Arch. Play 4 covers 750 mi^2 and lies at depths between 8,000 and 10,000 ft within the planning area (Fig. III.A.1.a(3)-2). Reservoir objectives include limestones and interbedded porous dolomites of the Lisburne Group (Mississippian-Pennsylvanian). Secondary porosity is enhanced in strata affected by leaching along erosional surfaces (unconformities). The Lisburne Group is 2,000 ft in maximum thickness within the play area and thins regionally northward (Molenaar, Bird, and Collett, 1986; Bird, 1988b). Potential traps are mostly associated with low-relief anticlinal structures along the Fish Creek platform and regional truncations at the base of the Sadlerochit Group (Permian unconformity). Petroleum charging was probably from the Ellesmerian petroleum system.

Play 5: Lisburne-Arctic Platform. Play 5 covers 3,126 mi^2 and lies between depths ranging from 9,000 to 15,000 ft within the planning area (Fig. III.A.1.a(3)-2). Reservoir objectives limestones and interbedded porous dolomites of the Lisburne Group (Mississippian to Pennsylvanian). The Lisburne Group thickens southward, ranging from 2,000 ft in the north to maximum thicknesses of 6,000 ft in the extreme southern part of the area (Molenaar, Bird, and Collett, 1986; Bird, 1988c). Potential traps are small anticlinal structures and subtle stratigraphic-wedge traps. Play 5 is considered more gas prone than the correlative play 4 along Barrow arch, and greater burial has probably negatively affected reservoir properties such as porosity and hydrocarbon yield factors. Petroleum charging was probably from gas-prone shales within the Lisburne and Endicott Groups that are deeply buried to the south of the play area.

Play 6: Sadlerochit-Barrow Arch. Play 6 covers 858 mi^2 and lies at depths between 7,000 and 9,000 ft within the

Figure III.A.1.a(3)-1



BEST COPY AVAILABLE

97

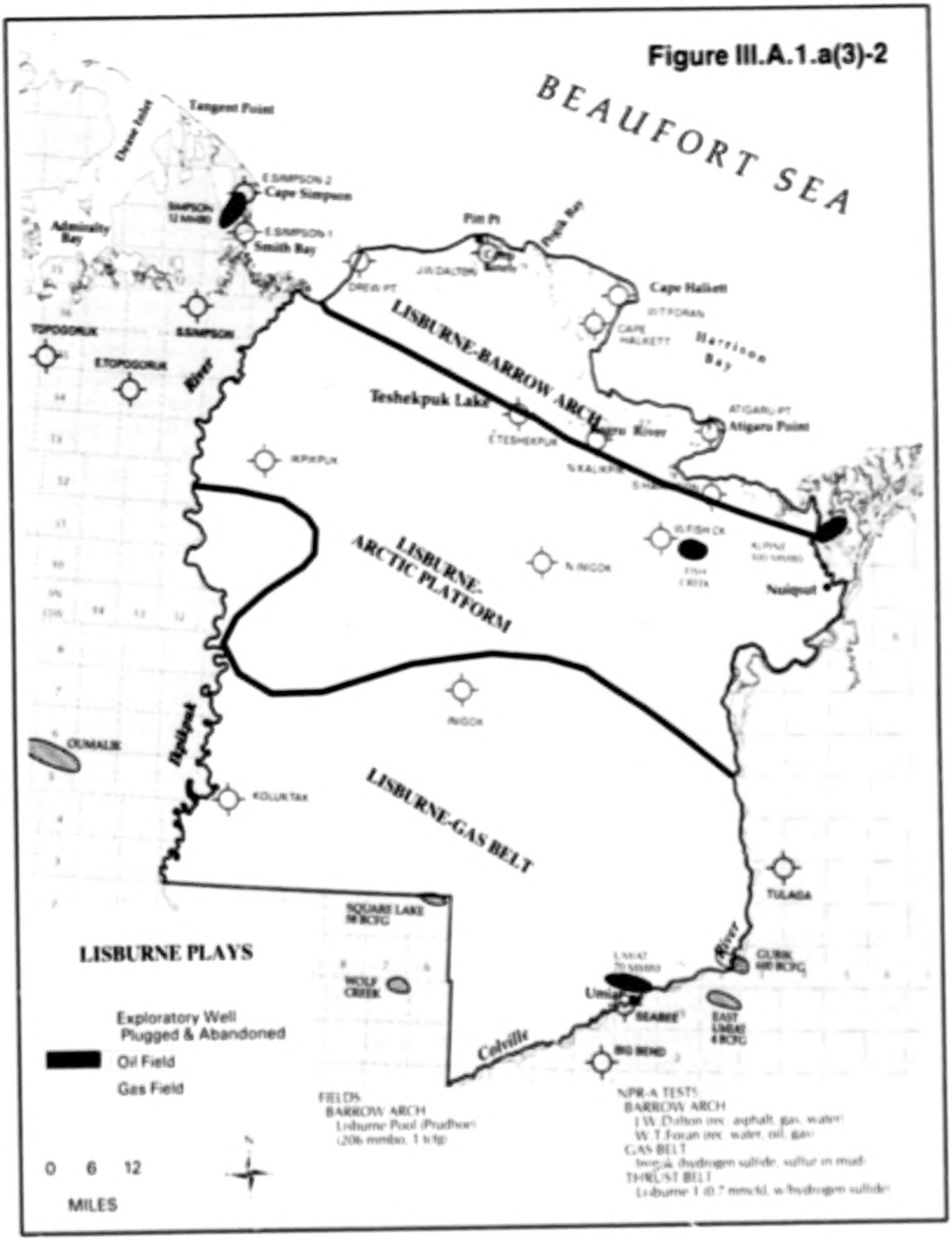


Figure III.A.1.a(3)-2

FIELDS
BARROW ARCH
Lisburne Pool (Prudhoe)
(206 mmbo, 1 tcfg)

NPR-A TESTS:
BARROW ARCH
J.W.Dalton (rec. asphalt, gas, water)
W.T.Foran (rec. water, oil, gas)
GAS BELT
Inigok (hydrogen sulfide, sulfur in mud)
THRUST BELT
Lisburne 1 (0.7 mmcfd, w/hydrogen sulfide)

BEST COPY AVAILABLE

planning area (Fig. III.A.1.a(3)-3). The primary reservoir objective is the Ivishak sandstone (Triassic) of the Sadlerochit Group. Sandstones of the Sag River Formation also may have reservoir petroleum, but this unit more typically lacks porosity and permeability. The Ivishak sandstone thins to <100 ft over structural highs like the Fish Creek platform, but thickens to >400 ft in local depocenters within the play area (Molenaar, Bird, and Collett, 1986; Tetra Tech, 1982). Average porosities are lower in the study area, reflecting a more shaley marine facies than correlative strata to the east at Prudhoe Bay. Potential traps are stratigraphic wedges produced by truncation of reservoir sandstones in the northernmost part of the play area, and low-relief anticlinal structures along the Fish Creek platform. Petroleum charging was probably from the Ellesmerian petroleum system.

Play 7: Sadlerochit-Arctic Platform. Play 7 covers 3,517 mi^2 and ranges in depths between 7,000 and 15,000 ft within the planning area (Fig. III.A.1.a(3)-3). The primary reservoir objective is the Ivishak sandstone (Triassic) of the Sadlerochit Group. Sandstones of the Sag River Formation is a secondary objective, but this unit generally has poor reservoir properties. The Ivishak sandstone ranges in thickness from 100 to 300 ft within this area (Tetra Tech, 1982). Average porosities are lower in the play area, reflecting a more shaley marine facies than correlative strata to the east at Prudhoe Bay. A history of deeper burial for play 7 also contributes to poorer reservoir properties relative to play 6. Potential traps are mostly small anticlinal structures along the southeastern flank of the Fish Creek platform (Fig. III.A.1.a(2)-4). Petroleum charging was probably from the Ellesmerian petroleum system, but due to deeper burial, play 7 is more gas prone than the correlative play 6 on the Barrow arch.

Play 8: Beaufortian-Barrow Arch. Play 8 covers 638 mi^2 and lies between depths of 2,000 and 8,500 ft in the planning area (Fig. III.A.1.a(3)-4). Reservoir objectives include the upper Kuparuk sandstone ("C" of Carmen and Hardwick, 1983), two Jurassic sandstones ("Nuiqsut" and "Nechelik" sandstones of Kornbrath et al., 1997), and the Simpson sandstone (Bird, 1988b). These sandstones offer multiple reservoir opportunities, but they probably do not overlap in any single prospect. The "Alpine" sandstone as defined by Kornbrath et al. (1997) is probably absent over most or all of the play area, because it was eroded at the Lower Cretaceous unconformity (LCU). The Simpson sandstones are probably confined to the northwestern part of the play area (Bird, 1988b). Potential traps recognized in seismic data are low-relief anticlines along Fish Creek platform and stratigraphic wedges created by erosional truncations at the LCU. Perhaps more common are subtle stratigraphic traps, where sandstone bodies are isolated within marine shales. Local depocenters on a low-relief Jurassic shelf created the accommodation space for accumulation and preservation of these shallow marine sands (Kornbrath et al., 1997). This latter trap type, similar to the Alpine field, is difficult to identify in seismic data. Petroleum charging was probably from the Ellesmerian! petroleum system. Charged sandstones within the play are expected to host "Barrow-Prudhoe" type crude oils averaging 28° in API gravity.

Play 9: Beaufortian-Arctic Platform. Play 9 covers 5,265 mi^2 and ranges between depths of 4,000 and 16,000 ft within the planning (Fig. III.A.1.a(3)-4). The Beaufortian sequence ranges from 1,700 to 3,700 ft in thickness within the play area (Bird, 1988b). Reservoir objectives include the Kuparuk "C" sandstone, three Jurassic sandstones ("Alpine," "Nuiqsut," and "Nechelik" sandstones; Kornbrath et al., 1997), and the Simpson sandstone. The Simpson sandstones are probably only present in the northwestern part of the play area (Bird, 1988b). The Jurassic sandstones present in the northern part of the area grade southward into shale. Although these sandstones offer multiple reservoir opportunities within the play, they probably do not actually overlap in any single prospect. Although the Alpine field lies near the southern margin of play 8, its extension into the northeastern NPR-A is included within play 9. Potential traps easily recognized in seismic data are low-relief anticlines along Fish Creek platform and stratigraphic wedges created by erosional truncations at the LCU. Perhaps more common are stratigraphic traps where sandstone bodies are isolated within marine shales. Local depocenters on a low-relief Jurassic shelf created the accommodation space for accumulation and preservation of these shallow marine sands (Kornbrath et al., 1997). These purely stratigraphic traps are is difficult to identify in seismic data. Petroleum charging was probably from the Ellesmerian! petroleum system, but because play 9 passes into a gas-only zone to the south, it probably contains lighter liquid hydrocarbons than the correlative play (8) along Barrow arch. Crude oils are modeled as averaging 35°API, with nearby fields containing 40°API crude at Alpine field and 38°API crude at Tarn.

Play 10: Beaufortian-Gas Belt. Play 10 covers 1,163 mi^2 and ranges in depths between 12,000 and 22,000 ft within the planning area (Fig. III.A.1.a(3)-4). The Beaufortian sequence thins southward across the play area from 3,200 ft on the north to <1,700 ft in the extreme south (Bird, 1988b). Beaufortian reservoirs within the play area consists of distal turbidites deposited on a south-facing continental slope and basin plain. All of these rocks are deeply buried and are expected to offer poor reservoir properties compared to their northern correlative plays (8, 9). The anticipated resource is natural gas derived from thermally overmature source-rocks of the Shublik, Kingak, and Pebble Shale formations.

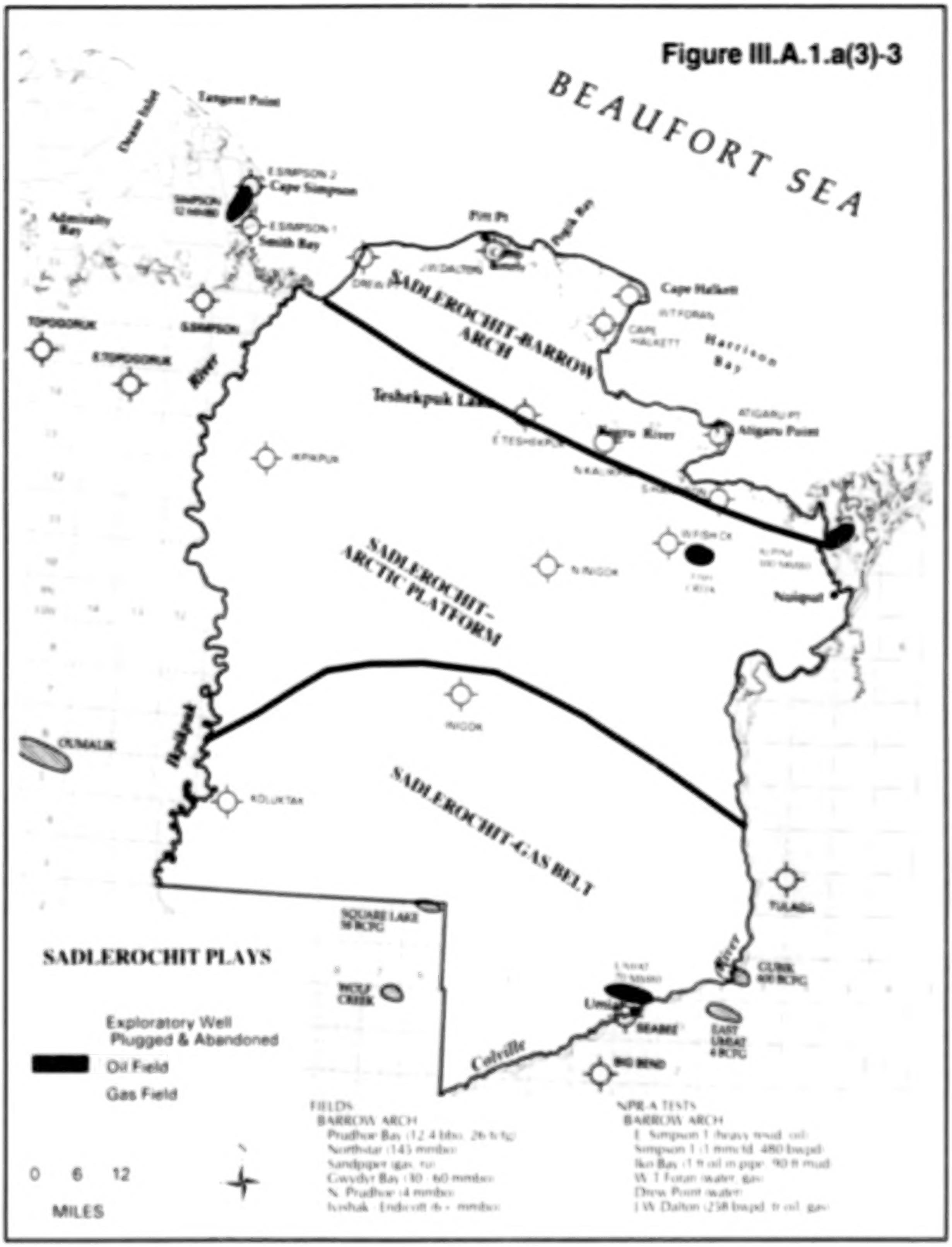
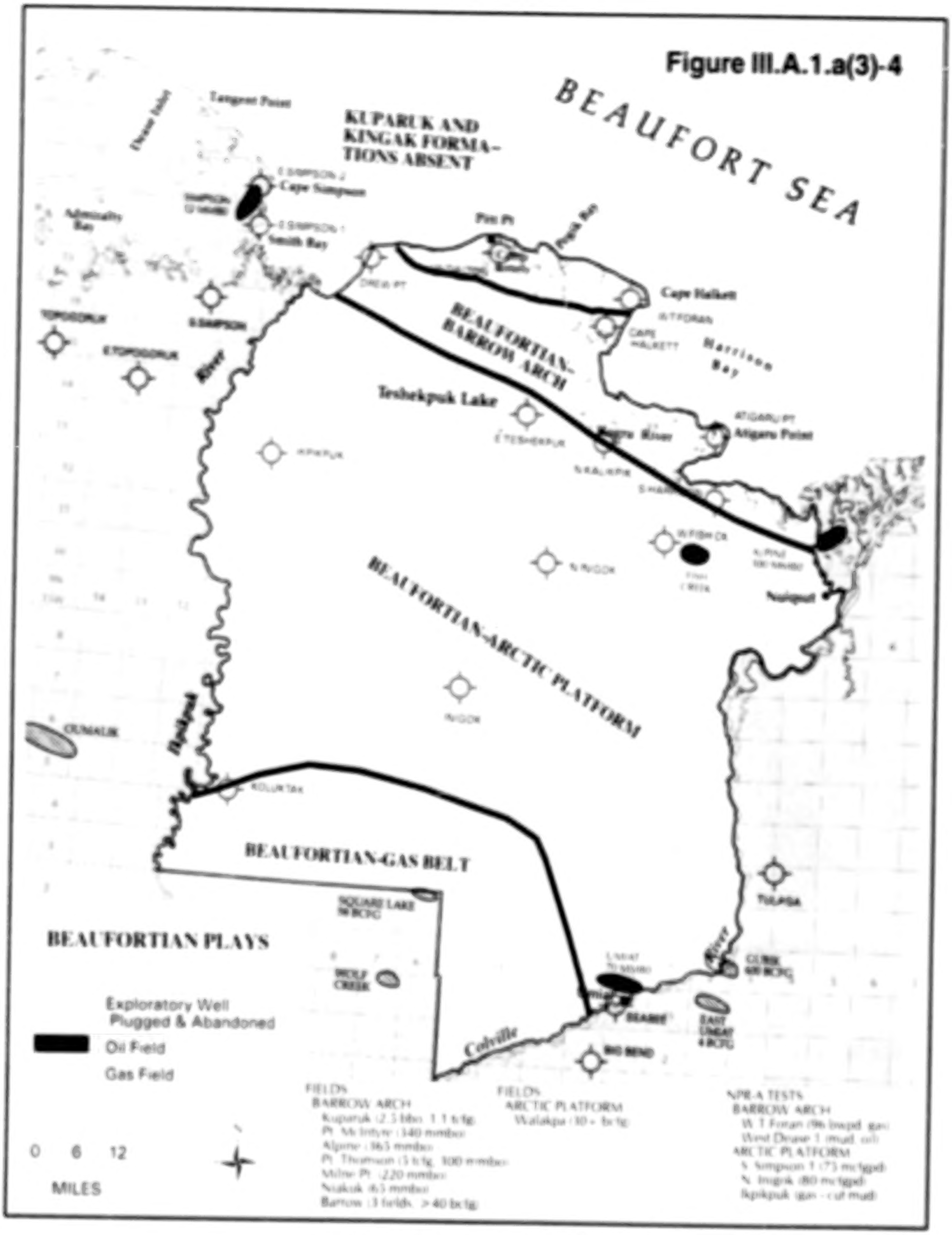


Figure III.A.1.a(3)-3

FIELDS
BARROW ARCH
Prudhoe Bay (12.4 bbo, 26 tcfg)
Northstar (143 mmbo)
Sandpiper (gas, ru)
Gwydyr Bay (30 - 60 mmbo)
N. Prudhoe (4 mmbo)
Ivishak - Endicott (6+ mmbo)

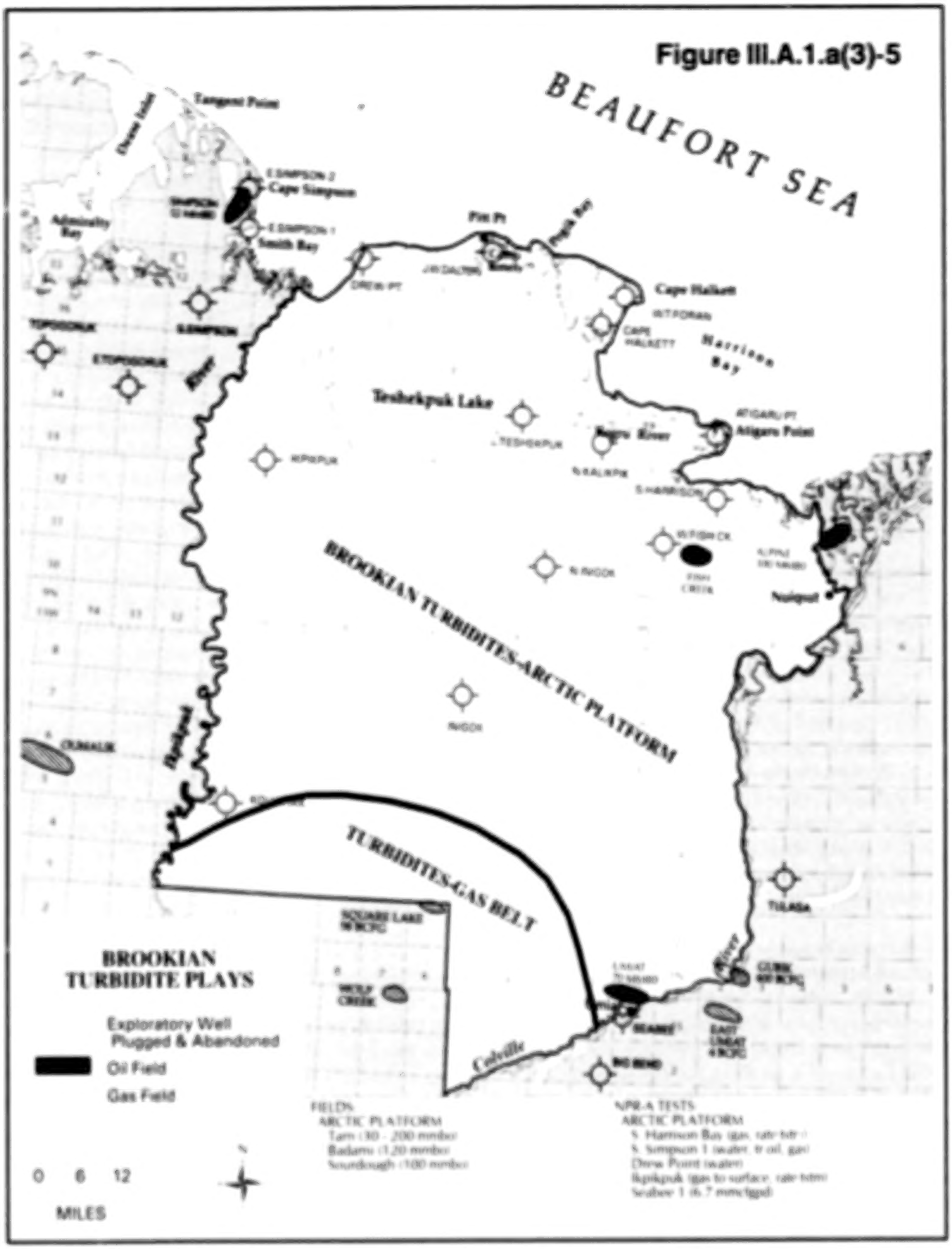
NPR-A TESTS
BARROW ARCH
E. Simpson 1 (heavy resid. oil)
Simpson 1 (1 mmcfd, 480 bwpd)
Iko Bay (1 ft oil in pipe, 90 ft mud)
W. T. Foran (water, gas)
Drew Point (water)
J.W. Dalton (258 bwpd, tr oil, gas)

BEST COPY AVAILABLE



BEST COPY AVAILABLE

Figure III.A.1.a(3)-5



FIELDS
ARCTIC PLATFORM
Tarn (30 - 200 mmbo)
Badami (120 mmbo)
Sourdough (100 mmbo)

NPR-A TESTS
ARCTIC PLATFORM
S. Harrison Bay (gas, rate tstm)
S. Simpson 1 (water, tr oil, gas)
Drew Point (water)
Ikpikpuk (gas to surface, rate tstm)
Seabee 1 (6.7 mmcfgpd)

BEST COPY AVAILABLE

102

Play 11: Brookian Turbidites-Arctic Platform. Play 11 covers 6,124 mi^2 and lies between depths of 2,000 to 16,000 ft within the planning area (Fig. III.A.1.a(3)-5). Turbidite sandstone reservoirs are generally confined to the lower 2,000 ft of the Early Cretaceous Torok Formation, which is predominantly a marine shale (Molenaar, Bird, and Collett, 1988). The turbidite sandstones were deposited in slope or basin-floor settings near the toe of the east-prograding Nanushuk-Torok delta system that ultimately filled the Colville basin (Huffman, Ahlbrandt, and Bartsch-Winkler, 1988). To the north, sandstones are generally sparse and thin, but contain moderate porosity. Submarine paleo-canyons in the area of the Fish Creek slump may have directed depositional trends and locally concentrated turbidite sandstone deposition. To the south, sandstones are abundant and relatively thick, but generally lack porosity because of deep burial. Most traps are probably stratigraphic in nature, consisting of bodies of turbiditic sandstones isolated within shales. These stratigraphic prospects will be difficult to map using seismic data. Petroleum charging of play 11 was probably from the thermally mature Shublik and Kingak source-rocks that directly underlie the Brookian turbidite reservoirs within the play area. Torok shales also form a potential source-rock, chiefly for gas.

Play 12: Brookian (Turbidites)-Gas Belt. Play 12 covers 1,051 mi^2 and lies between depths of 14,000 to 20,000 ft within the planning area (Fig. III.A.1.a(3)-5). The Torok Formation contains the turbidite sandstone reservoirs in its lowermost 2,000 ft. Extensive destruction of pore systems is expected because of compaction associated with deep burial. Most traps are fault-bend folds related to thrust-fault deformation of the Torok Formation in the foreland foldbelt north of the Brooks Range. Some stratigraphic traps, consisting of bodies of turbidite sandstones isolated within shales, are probably also present. The only anticipated resource is natural gas derived from overmature Shublik and Kingak source-rocks, in addition to gas derived from Torok shales.

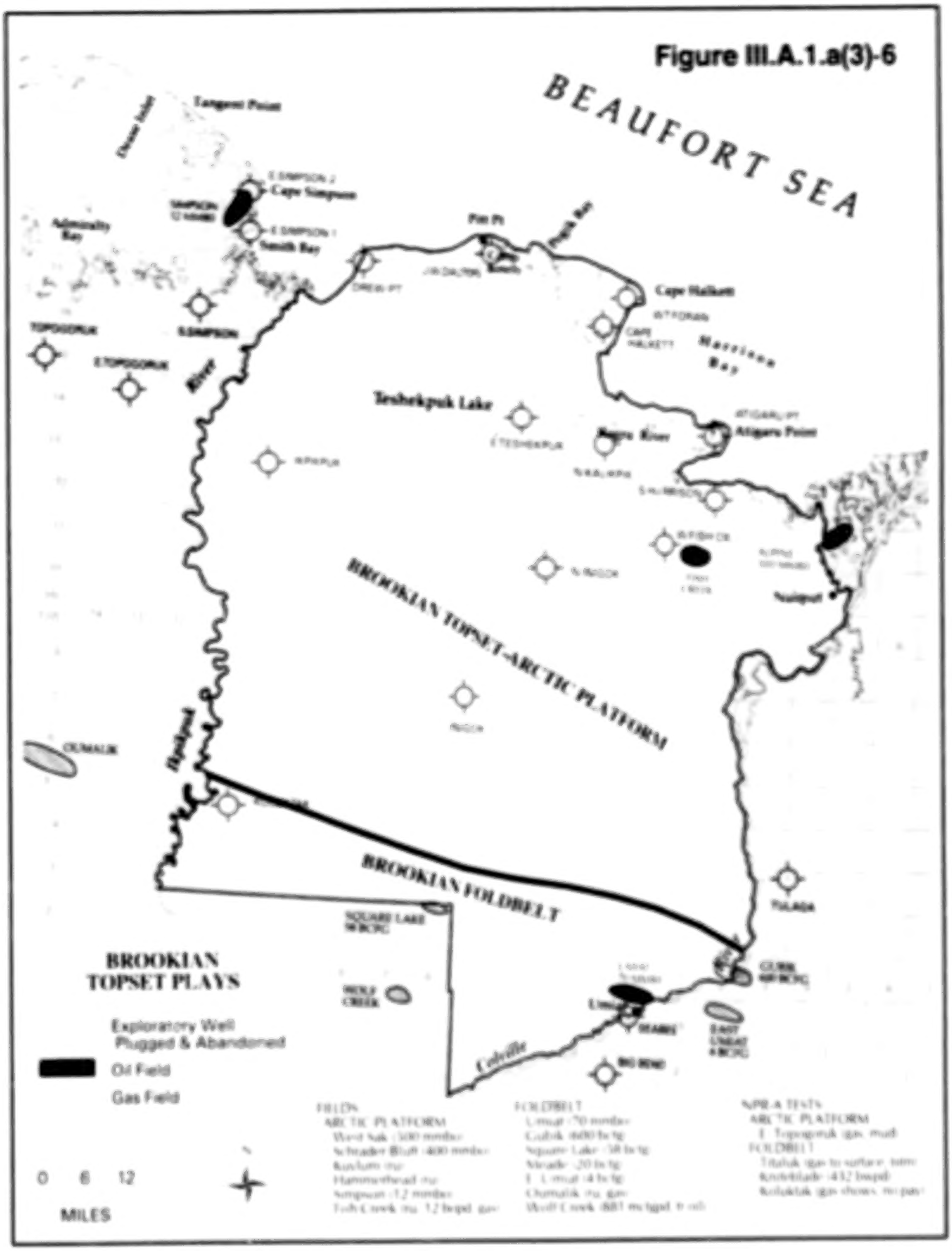
Play 13: Brookian Topset-Arctic Platform. Play 13 covers 6,019 mi^2 and lies between depths ranging from <1,000 ft (actually the land surface) to 6,000 ft within the planning area (Fig. III.A.1.a(3)-6). Within the planning area, the Brookian topset strata consist mostly of Early Cretaceous deltaic rocks assigned to the Nanushuk Group. Potential reservoirs include fluvial and shallow marine sandstones that were deposited as distributary-mouth bars on eastward prograding delta systems (Huffman, Ahlbrandt, and Bartsch-Winkler, 1988; Molenaar, Bird, and Collett, 1988). Sandstones of the topset play are shallow water equivalents to the deep-water turbidite sandstones included in plays 11 and 12. Within the play area, the Nanushuk Group ranges in thickness from 0 to 3,500 feet (Bird, 1988b). Sandstones within the Nanushuk Group have generally not been deeply buried, so they often preserve modest porosities, but fine grain size and high clay contents are detriments to reservoir quality (Huffman, Ahlbrandt, and Bartsch-Winkler, 1988). Petroleum charging of play 13 is possible from the thermally mature Shublik and Kingak source-rocks that underlie the Colville basin. Torok shales also constitute a potential gas-prone source rock. However, several thousands of feet of overpressured shale intervene between shallow sandstone reservoirs and the deep, thermally mature petroleum sources. Potential trapping mechanisms are entirely stratigraphic, where pinchouts form local traps for sandstone bodies.

Play 14: Brookian Foldbelt. Play 14 covers 1,156 mi^2 and lies between depths of <2,000 ft (actually the land surface) to 6,000 ft within the planning area (Fig. III.A.1.a(3)-6). The reservoir objectives are predominant Nanushuk group (Lower Cretaceous) sandstones similar in lithology to play 13. The Nanushuk Group ranges from 1,000 to 5,000 ft in thickness (Molenaar, Bird, and Collett, 1988). As the foldbelt trends eastward out of the NPR-A, younger rocks of the Colville Group (Upper Cretaceous) could offer shallow reservoir objectives. Sandstones within the Nanushuk Group have been more deeply buried than those in play 13, but are generally coarser-grained with moderate porosities. Clay content and compaction of soft clasts are the greatest detriments to reservoir porosity (Huffman, Ahlbrandt, and Bartsch-Winkler, 1988). Traps are mostly large folds, up to 140,000 acres in area, that formed over deeper thrust faults. Petroleum charging was probably from the thermally mature Pebble Shale and Kingak source-rocks deep within the Colville basin. Torok shales also form a source, probably mostly for gas. However, several thousands of feet of overpressured Torok shales intervene between shallow Cretaceous reservoirs and the deep source-rocks. Access to migrating petroleum created by this shale barrier may be a significant problem for some prospects in this play, although several oil and gas accumulations (for example, Umiat) have been discovered in the play area.

3) Geologic Modeling Approach: Comparisons are likely to be made between this assessment and previous work. The principal difference between the 1997 MMS/BLM assessment and 1995 USGS assessment is that the present work is focused specifically on the northeastern NPR-A, as opposed to the broader USGS assessment of the entire northern Alaska petroleum province. In addition, there are also three main conceptual differences between the 1995 USGS and the 1997 MMS/BLM assessments.

1. The present assessment recognizes the high potential for oil in the Endicott, Sadlerochit, Lisburne, and Beaufortian Groups on the south flank of the Barrow Arch. The USGS concluded that a broad area of the Arctic Platform offers

Figure III.A.1.a(3)-6



FIELDS
ARCTIC PLATFORM
West Sak (300 mmbo)
Schrader Bluff (400 mmbo)
Kuvlum (?)
Hammerhead (?)
Simpson (12 mmbo)
Fish Creek (?, 12 bopd, gas)

FOLDBELT
Umiat (70 mmbo)
Gubik (600 bcfg)
Square Lake (58 bcfg)
Meade (20 bcfg)
E. Umiat (4 bcfg)
Oumalik (?, gas)
Wolf Creek (881 mcfgpd, tr oil)

NPR-A TESTS
ARCTIC PLATFORM
E. Topagoruk (gas, mud)
FOLDBELT
Titaluk (gas to surface, tstm)
Knifeblade (432 bopd)
Koluktak (gas shows, no pay)

BEST COPY AVAILABLE

104

only gas potential in these reservoirs. The USGS analysis is not consistent with available thermal maturity data (data in Johnsson, Howell, and Bird, 1993).

2. The 1995 USGS assessment did not assign any particular importance to the Beaufortian play. That was not an oversight, in that the Alpine discovery was announced as a commercial field in October of 1996, after the USGS assessment was completed. This situation is fairly common to resource-assessment work, where new information can greatly alter perceptions of oil and gas potential. Alpine was the largest oil discovery on the North Slope in nearly a decade, with reserve estimates of 365 MMbbl. Kornbrath et al. (1997) discussed the Alpine field stratigraphy and concluded that "within eastern NPR-A, Jurassic and Lower Cretaceous rocks of the Beaufortian Sequence . . . are the most likely reservoirs for commercial oil deposits." The MMS/BLM assessment acknowledges the importance of this new play.

3. The 1995 USGS assessment assigned a relatively large fraction (38%) of the undiscovered oil resources to the Brookian Topset and Brookian Turbidite plays. These plays were thought to contain large numbers of pools ranging in size to 500 MMbbl, accounting for mean undiscovered oil resources in these two plays of 2.8 Bbbl. This optimistic assessment may have been influenced by the 40 Bbbl (in-place) heavy oil deposits in the West Sak and Schader Bluff reservoirs in the nearby Kuparuk and Milne Point fields. The MMS/BLM assessment of the correlative play (Brookian topset, play 13) models fewer pools of smaller sizes, producing a much smaller undiscovered resource potential in these Brookian plays.

Although numerous parameters are used as input to the GRASP computer model, a few key variables exert a controlling influence on the assessment results.

Prospect number and size distributions were determined mostly from available mapping in the study area by a private company (Tetra Tech, 1982). We found that mapped prospects were more numerous and larger in size in the Barrow Arch plays compared to the Arctic Platform plays. Because Tetra Tech did not map any prospects in the Brookian play group, prospect number and size distributions were extrapolated from correlative plays on the Chukchi shelf (Sherwood, 1996). Within the Brookian Foldbelt play, offshore assessment data from the Chukchi Sea compare favorably with Tetra Tech maps in the NPR-A.

Unidentified prospects were estimated for each play. In most petroleum provinces, it is generally conceded that large numbers of prospects remain undetected, even in the most thoroughly mapped areas. "Unidentified" prospects exist for a variety of reasons. Some areas lack sufficient seismic data to map all prospects. Smaller prospects may have been missed because they fall between widely spaced seismic lines, or stratigraphic prospects might have been missed because the seismic data lacks sufficient resolution of subsurface detail. Many areas (particularly frontier areas) have not been tested enough by drilling to thoroughly understand the geology and complex relationships which combine to produce oil and gas pools. Often, new fields are found when drilling to reach another reservoir target.

Because unidentified prospects could contain significant resource volumes, they should be accounted for in assessments of oil and gas potential. For each of the 14 geologic plays, we supplemented the numbers of known (mapped) prospects with additional unidentified prospects. Estimates of unidentified prospect number considered the completeness of mapping, well control, and the geologic complexity. In areas of complex stratigraphy or structure, sparse seismic data or well control, and uncertain geology (timing, migration paths, reservoir stratigraphy), relatively large fractions of the prospect numbers are likely to be unidentified. Beaufortian plays, for example, are thought to contain primarily stratigraphic prospects, so equal numbers of unidentified and mapped prospects were used in the prospect number distributions. Among all 14 plays, a total of 194 mapped prospects were identified by existing mapping, and an additional 477 unmapped, unidentified prospects were assumed to be present in the planning area.

Prospect burial depths have well-documented effects on reservoir properties. Most of the plays identified within the planning area have been subjected to similar extremes in burial depth, temperatures, and thermal maturities as correlative plays in the adjacent offshore area. Reservoir characteristics that are sensitive to burial depth (for example, yield factors, gas-oil ratios, gas expansion factors) were taken from the MMS offshore database. Yield factors reflect the balance between depositional environment and post-depositional destructive processes related to burial conditions. The deep burial histories of the Beaufortian and older plays in the Gas Belt areas have adversely affected reservoir properties. In contrast, reservoirs in plays along the Barrow Arch have not been deeply buried, and repeated exposures of strata at erosional unconformities have often enhanced porosities. The highest yield factors (bbl/acre-foot) were assigned to the Barrow Arch plays and the lowest yield factors were assigned to Gas Belt plays. Arctic Platform plays offer intermediate reservoir yield factors.

The *proportion of oil and gas* in reservoirs is another key variable in the assessment. The principal oil sources known to occur in northern Alaska (Shublik, Kingak, and Pebble Shale) underlie all of the study area. Oil generated by these source-rocks upon thermal maturation should have migrated into overlying (Beaufortian and Brookian) strata or northward (updip) toward the Barrow Arch. Consequently, the plays along the Barrow Arch have the highest probability for pooled oil (oil/gas=76/24). For the Lisburne and Endicott plays on the Arctic Platform, reservoirs lie below recognized oil source-rocks and hydrocarbons must be generated from unknown Paleozoic sources. Accordingly, the probability for oil pools is much smaller (oil/gas=35/65 to 55/45). Shallow reservoirs in the Brookian Topset play are isolated from underlying oil sources by several thousand feet of shales (largely gas prone and often overpressured). With less access to migrating oil, the occurrence of oil pools in Brookian topset reservoirs is less probable (oil/gas=45/55) than underlying Brookian Turbidite reservoirs that lie closer to oil sources (oil/gas=62/38). Gas Belt plays are universally assigned an all-gas (oil/gas=0/100) mix.

Effective *reservoir (pay) thickness* is a dominant factor controlling potential storage volumes and recovery from oil and gas pools. The depositional thicknesses of sandstone formations in the Beaufortian and Ellesmerian plays were probably greatest along the Barrow Arch. However, subsequent erosional events have truncated these rocks in the northern NPR-A. Although sandstone formations deposited on the Arctic Platform have greater preservation potential, they generally become more shaley and deeply buried to the south, with adverse affects on porosity. As a result of these very different processes, we concluded that reservoir pay thicknesses are relatively similar for the Barrow Arch and Arctic Platform play groups. Pay thicknesses in Beaufortian and older plays in the Gas Belt areas are much lower because of distal depositional environments and destruction of porosity/permeability related to deep burial.

Exploration chance of success reflects the likelihood that oil and gas accumulations are present in the plays (play chance) and what proportion of the prospects are expected to be actual pools (average prospect chance). The input chance for success is predicated on geological factors, rather than economic factors, in the GRASP model. Geologic success is defined as the existence of conventionally pooled hydrocarbons that can be recovered from a wellbore. Conventional hydrocarbon accumulations do not include continuous-type deposits (non-pooled) or those not recoverable by standard technology. For most play groups, exploration chances for success are highest along the Barrow Arch. This structural trend has focused migrating hydrocarbons, Ellesmerian and Beaufortian rocks are in a more proximal setting (higher quality reservoirs), and a variety of trapping mechanisms are present. In contrast, the low exploration chances for the Gas Belt plays reflect distal facies (poor reservoirs), the destruction of reservoir quality and oil content (deep burial history), and the general lack of obvious trapping mechanisms.

4) Geologic Assessment Results: The assessment of conventionally recoverable hydrocarbon potential is summarized as a cumulative probability graph (Fig. III.A.1.a(3)-7) which represents the aggregation of all 14 geologic plays analyzed in the study area. Separate curves are shown for oil (including crude oil and natural gas liquids), gas (including nonassociated and dissolved gas), and BOE, which is a sum of the energy contents of both oil and gas. These resources represent *pooled hydrocarbons recoverable using conventional technology without regard for economic viability.*

The graph (Fig. III.A.1.a(3)-7) illustrates a very important concept; the volumetric estimates of undiscovered resources should be viewed in the context of probability to account for the inherent uncertainties associated with evaluating undiscovered resources. It is apparent that there is a much higher probability of occurrence for small resource volumes than for large resource volumes. For example, there is a 95-percent chance (19-in-20 chance) that the area contains at least 1.8 Bbbl of oil, and there is a 5-percent chance (1-in-20 chance) that the study area contains 4.7 Bbbl of oil or more. This represents more than a twofold increase based entirely on the probability level. Other probabilities can be selected for statistical summaries (for example, 90%, or 1-in-10 chance). More frequently, the mean (or average) of the distribution is used to compare or sum results for different plays or areas. Important concepts to remember are: (1) a wide range of possibilities for resource potential is typical for estimates because geologic assessment is not an exact science; and (2) potential resource volumes should be viewed with respect to probability.

To summarize the information contained in the cumulative probability curves, the risked mean oil volume (including crude oil and gas-condensate) is 3.070 Bbbl, and the risked mean gas volume (including both associated and nonassociated gas) is 9.852 Tcf. These average (or expected) volumes fall within fairly wide ranges of resource potential. Recoverable oil volumes could range from 1.832 to 4.732 Bbbl (95% and 5% probabilities), and corresponding gas volumes could range from 3.190 to 21.674 Tcf (95% and 5% probabilities).

The individual contributions by the 14 plays is given in Table III.A.1.a(3)-1. Reported play endowments are provided for 95-percent probability (F95), mean, and 5-percent probability (F05) levels. It is apparent that three plays (Sadlerochit-Barrow Arch; Beaufortian-Barrow Arch; Beaufortian-Arctic Platform) dominate the resource potential of the planning area, contributing 77 percent of the total oil potential and 68 percent of the total gas potential. Two other plays are of secondary importance (Endicott-Barrow Arch; Brookian-turbidites), and together these plays contribute 6 percent of the total oil resources.

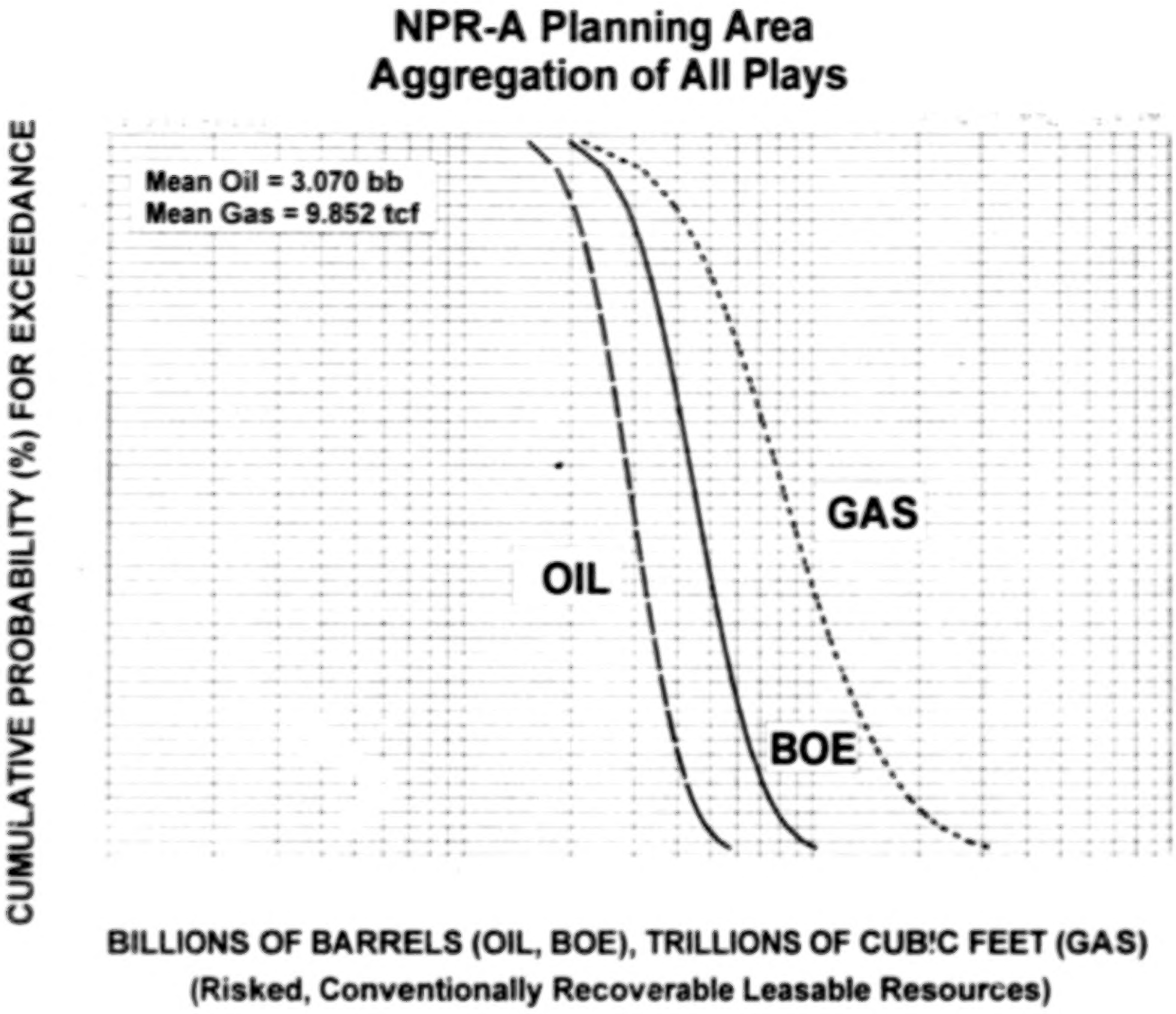


Figure III.A.1.a(3)-7. Cumulative Probability Graph of Conventionally Recoverable Hydrocarbon Resources. Resource volumes should be viewed with regard to probabilities to account for the uncertainties inherent in resource estimation. Higher resource volumes are typically associated with lower probabilities of occurrence.

It is important not to focus exclusively on the reported mean resource volumes and consider the range associated with each play. Under favorable conditions, large pools (perhaps rare, but possible) in some of the poor plays could become commercial fields.

(d) Economic Assessment: The purpose of the economic assessment is to determine what proportion of the undiscovered conventionally recoverable endowment could be commercial (that is, produced at a profit) under given engineering and economic conditions. The analysis is performed by the PRESTO computer program, which models typical activities progressing from the discovery of a new pool to the delivery of hydrocarbons to a market destination. The PRESTO model simulates the scheduled expenses associated with discovery, development, and production that are offset by the income from sale of the commodity. A discounted cash-flow analysis is performed to determine net present worth under the given set of randomly sampled geologic (reservoir characteristics), engineering (costs, scheduling), and economic variables. Each PRESTO run includes 1,000 trial simulations, where pools in each play are developed and produced under changing conditions. Those pools having positive net present value are statistically aggregated to produce economic recoverable resource estimates.

It is important to acknowledge that the computer simulations are made without exact knowledge of the location of the modeled pools (which are undiscovered at present). Accordingly, the site- specific development

Table III.A.1.a(3)-1 Play Resources in the Northeast NPR-A Planning Area

Volumes shown below are undiscovered, risked, conventionally recoverable hydrocarbon resources

Play No., Name	UAI	Oil Endowment (mmbo)*			Gas Endowment (tcfg)		
		F95	Mean	F05	F95	Mean	F05
1. Endicott-Barrow Arch	UBPA0101	42	261	837	0.094	0.781	2.253
2. Endicott-Arctic Platform	UBPA0201	–	3	8	–	0.044	0.117
3. Ellesmerian-Gas Belt	UBPA0301	–	5 **	15 **	–	0.194	0.638
4. Lisburne-Barrow Arch	UBPA0401	35	143	309	0.044	0.367	0.928
5. Lisburne-Arctic Platform	UBPA0501	–	0.4	2	–	0.007	0.038
6. Sadlerochit-Barrow Arch	UBPA0601	324	834	1,964	0.652	2.123	4.245
7. Sadlerochit-Arctic Platform	UBPA0701	–	40	132	–	0.254	0.833
8. Beaufortian-Barrow Arch	UBPA0801	476	871	1,839	1.031	2.780	6.282
9. Beaufortian-Arctic Platform	UBPA0901	364	656	1,196	0.887	1.618	2.799
10. Beaufortian-Gas Belt	UBPA1001	–	1 **	2 **	–	0.028	0.075
11. Brookian Turbities	UBPA1101	118	192	288	0.611	1.071	1.763
12. Brookian-Gas Belt	UBPA1201	–	2 **	10 **	–	0.084	0.376
13. Brookian Topset	UBPA1301	–	20	76	–	0.179	0.559
14. Brookian Foldbelt	UBPA1401	–	41	186	–	0.321	0.940
FASPAG Aggregation-Oil Plays	**UBPA0001**	***1,825***	***3,062***	***4,724***	***3.004***	***9.546***	***21.285***
FASPAG Aggregation-All Plays	**UBPA0002**	***1,832***	***3,070***	***4,732***	***3.190***	***9.852***	***21.674***

* Includes condensate (or natural gas liquids) dissolved in gas

** 100% condensate

aspects of future fields could differ somewhat from the generalized engineering scenarios modeled by PRESTO.

The rate at which new discoveries are made and eventually converted into production is not provided in the output of the PRESTO computer model, although numerous simulations are tested internally. In the real world, economic factors, such as future price expectations and technological advancements, strongly influence corporate strategies and exploration efforts. For example, the perception of higher oil prices could spark industry interest in exploring an area. Increased exploration is likely to result in more discoveries and production of greater portions of undiscovered resources. A contrary set of circumstances, such as a series of dry exploration tests and low oil prices, could force industry to abandon the area before any significant discoveries are made. These intangible circumstances do not affect the resource estimates calculated by the PRESTO model.

The economic assessment results are influenced, to a large degree, by the preceding geologic assessment. This is because pool characteristics determined by the GRASP geologic model are transferred as input to the PRESTO economic model. Although variables are randomly sampled (Monte Carlo sampling), there is a strong central tendency favoring the midpoints of the various input distributions. Although extreme cases are possible, generally this means that poor geologic plays are likely to be evaluated as poor economic plays.

1) Economic Modeling Approach: The detailed operational aspects of the PRESTO computer model are beyond the scope of the present report. Instead, some key differences between the 1995 USGS modeling approach (Attanasi and Bird, 1995) and the 1997 MMS/BLM assessment are briefly discussed to provide some insight into PRESTO modeling.

Although the present assessment is described as a play analysis, in fact, *the basic units of the economic model are* *individual pools*. The PRESTO conducts a pool-by-pool sampling and development simulation under changing geologic, engineering, and economic variables. Pools that have positive present net worth are combined into multipool developments within each play, and then the plays are combined into overall development scenarios for the area in each of the 1,000 trials for a modeling run. The USGS approach takes a broader conceptual view, where only fields above a certain minimum size are aggregated into play and area totals. The PRESTO model seems to better replicate the variability in states-of-nature, where *the viability of individual prospects is repeatedly tested under a variety of randomly sampled conditions*.

Because of this prospect-level focus, the present analysis places greater importance on prospect mapping using seismic data. Structural prospects are generally obtained from regional maps in the study area or extrapolated from maps in adjacent areas containing the same plays. To account for prospects that are difficult to map ("unidentified" prospects), extrapolations are made from geologic analogs. The USGS approach relies more on analogs than actual prospect mapping.

The present assessment makes the assumption that *each prospect will be developed as a stand-alone field*; that is, its development will include the total capital costs of exploration and appraisal wells, infield processing facilities, and a sales-oil pipeline. Facilities sharing is not directly modeled at the prospect level, but could enter into higher order development models such as multiple prospects within a play or multiplay developments. These capital costs are scheduled throughout the life of the modeled project. Tariffs (per-barrel expenses) are used only for existing infrastructure, such as the TAPS pipeline tariff. The USGS approach used tariffs for new infrastructure, such as play-level pipeline systems.

The PRESTO utilizes matrix tables for key cost components (wells, production facilities, pipelines, and others) to provide sampling variability. For example, the exploration well cost matrix includes incremental cost differences for drilling depth and distances from existing infrastructure. For any particular combination of depth and distance, costs in the matrix vary by 25 percent from the most-likely (mode) value. Consequently, the opportunity for variability is built into the PRESTO computer program to provide a more realistic simulation model.

One area of similarity between the MMS and USGS modeling involves economic parameters. Economic assumptions were purposely defined to allow for a more direct comparison between 1995 USGS and 1997 MMS/BLM assessments results. The present economic analysis assumes 1997 as the base year. Commodity prices and development costs are inflated at a constant rate; that is, flat real price and cost paths are assumed. Key economic parameters (input as constants) are listed below:

•inflation	2.5%
•discount rate	12%
•Federal income tax	35%
•State income tax	2% (effective)
•royalty rate	16.67%
•property tax	$0.50/bbl (approximated)
•severance tax	$1.00/bbl (approximated)
•TAPS tariff	$2.80/bbl
•tanker tariff	$1.53 (West Coast delivery)

A *gravity price adjustment was made for each play* to reflect differences in petroleum value. For example, typical 28° API North Slope crude oil received a -$.60 price adjustment as scaled to a 32°API World Oil price. This price differential is quite significant when comparing relatively heavy oil (20° API, -$1.80 adjustment) to light oil (40° API, +$.90 adjustment). The 1995 USGS assessment did not account for this gravity price adjustment, standard for crude-oil delivery to West Coast markets.

2) Economic Assessment Results:

The results of the economic evaluation are summarized as price-supply curves that relate the volumes of resources (horizontal axis) to oil prices (vertical axis). Oil price is considered to be the independent variable and resource volume is the dependent variable. Price-supply curves are constructed from many PRESTO modeling runs made at different starting commodity prices. Typically, increases in the commodity prices result in corresponding increases in the volumes of oil or gas that can be profitably recovered. This is because the increased value of the resource (at higher real prices) more than offsets the development costs, given the same field characteristics. At very high (perhaps unrealistic) prices, the economically recoverable resource curves approach the conventionally recoverable endowment.

Several important assumptions are intrinsic to the analysis:

- The price-supply curves do not imply that the estimated resources will be discovered or produced within a specific timeframe, only that they are *available* in the area. In the PRESTO model, all pools are "discovered" and then developed by simulation. In the real world, there is no guarantee that enough wells will be drilled to adequately test the area, and the estimated resource potential may never be realized as petroleum production.
- The analysis assumes that the entire planning area is open for leasing and that access for exploration and development is not restricted by closures or regulations.
- No attempt is made to upgrade the engineering technology or development strategies that might occur

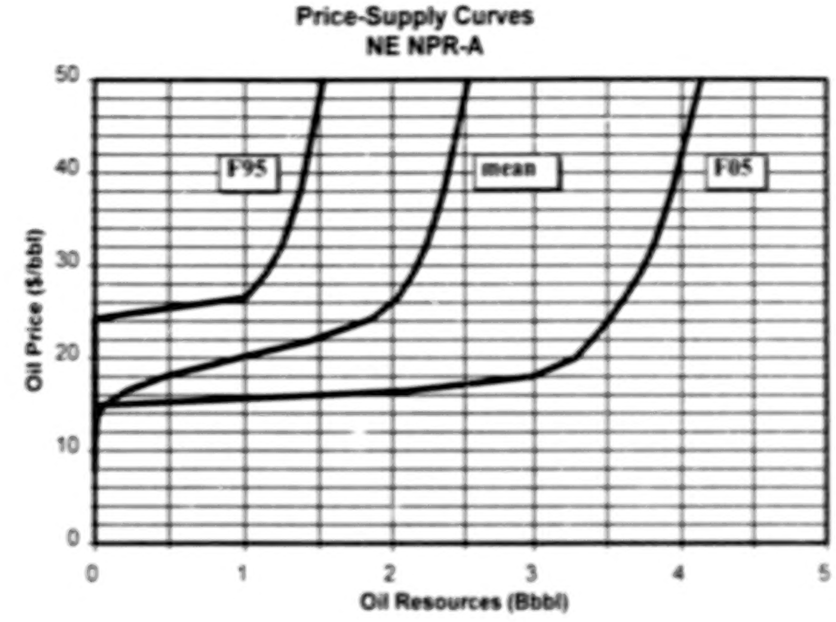


Figure III.A.1.a(3)-8. Price-Supply Curves for Economically Recoverable Oil Resources. Economic volumes are highly dependent on oil price, where higher prices support the exploration and development of more petroleum resources. Three probability levels are shown: *F95* represents a 95-percent probability, *mean* represents the average (or expected) case, *F05* represents a 5-percent probability.

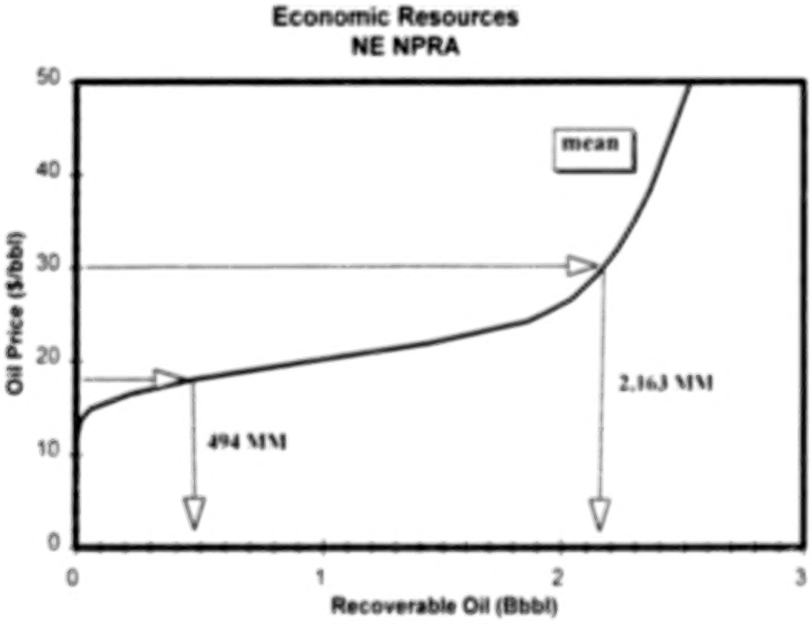


Figure III.A.1.a(3)-9. Estimates for Economically Recoverable Resources in the Planning Area. The mean price-supply curve is used to represent the average, or expected, case. Two representative oil prices can be assumed to bracket reasonable future commodity prices. The resource volumes correlated to these representative prices are undiscovered oil resources expected to be commercial under the assumed economic conditions. The analysis does not imply that these resources will ever be leased or discovered, merely that they are present and potentially recoverable.

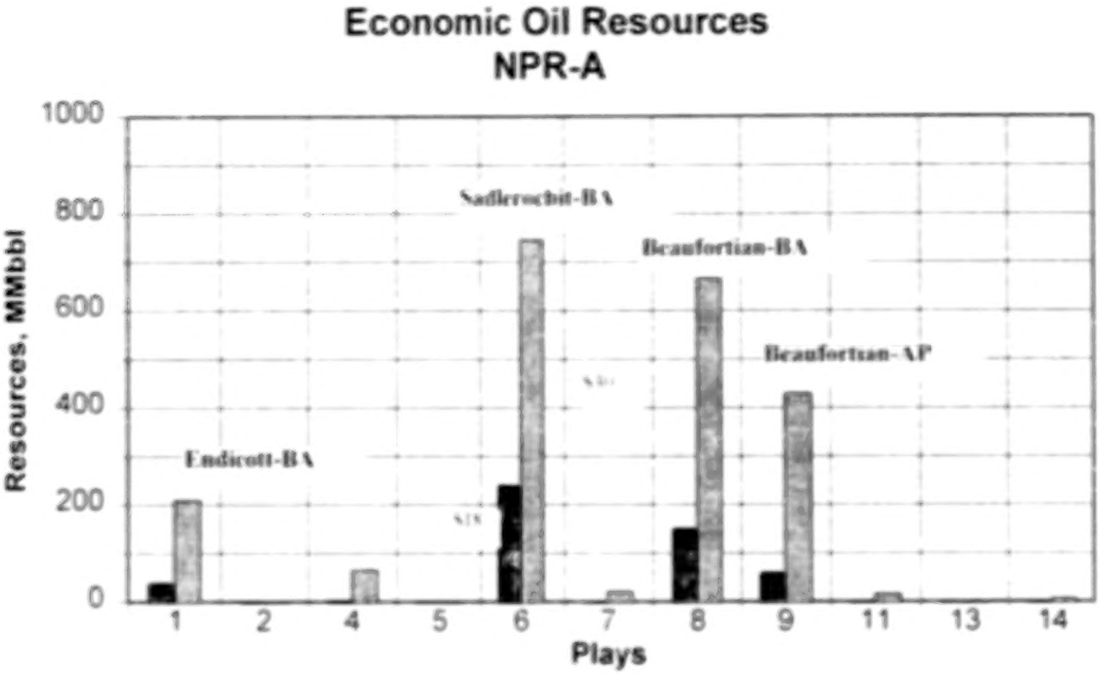


Figure III.A.1.a(3)-10. Play Contributions to Economic Oil Resources. The economic potential is not uniformly distributed among the geologic plays assessed. Three plays contain the majority of both the conventionally recoverable and economic resources. Correlative reservoirs in the Sadlerochit group and Beaufortian sequence account for nearly all North Slope oil production.

as a response to higher commodity prices. Standard engineering technology and current North Slope development concepts are assumed in the modeling.

- *Price-supply curves are models of risked resources*, including both the *geologic risk* that pooled and recoverable hydrocarbons are present and the *economic risk* that only a fraction of these pooled resources will be profitable to produce (if discovered).

Similar to the reporting of conventionally recoverable (geologic) results, economic assessments should be viewed in the context of probabilities. Figure III.A.1.a(3)-8 is a price-supply graph containing three curves, corresponding to 95-percent probability (F95), mean, and 5-percent probability (F05) levels. The low case is represented by a 95-percent probability (19-in-20 chance) for economic oil volumes in the area. The mean curve represents average (or expected) oil volumes. The F05 curve represents a high case, where there is a 5-percent probability (1-in-20 chance) that large resource volumes are present and commercially recoverable.

This graph (Fig. III.A.1.a(3)-8) illustrates the range in undiscovered resources that could be available for commercial development in the northeastern NPR-A under different price and probability conditions. For example, if a high probability (19-in-20 chance, F95) is required, then oil prices must rise above $24/bbl to ensure economic viability. At current prices (assume $18/bbl), approximately 0.500 Bbbl are economically recoverable for the mean (expected) case. By accepting more risk (1-in-20 chance, F05 curve) nearly 3.0 Bbbl could be economically recoverable at $18/bbl prices. Thus, the range in economic resource potential at $18/bbl oil prices varies from 0.0 to 3.0 Bbbl, depending on the probability level. Note that at prices below $15/bbl, no economic resources are present, even at high-risks (F05).

Changing commodity prices (in real, or constant dollar terms) have large corresponding effects on economically recoverable volumes. Higher commodity prices invariably lead to higher resource estimates. Because the resource estimates will be used primarily for lease sale planning and environmental impact analysis, some reasonable limits must be established. The mean (or expected) resource case is selected because it represents the average outcome of the economic analysis (Fig. III.A.1.a(3)-9). To bracket potential oil production, two price levels are assumed. The $18 price represents current economic conditions, and the $30 price represents the upper end of reasonable long-term

111

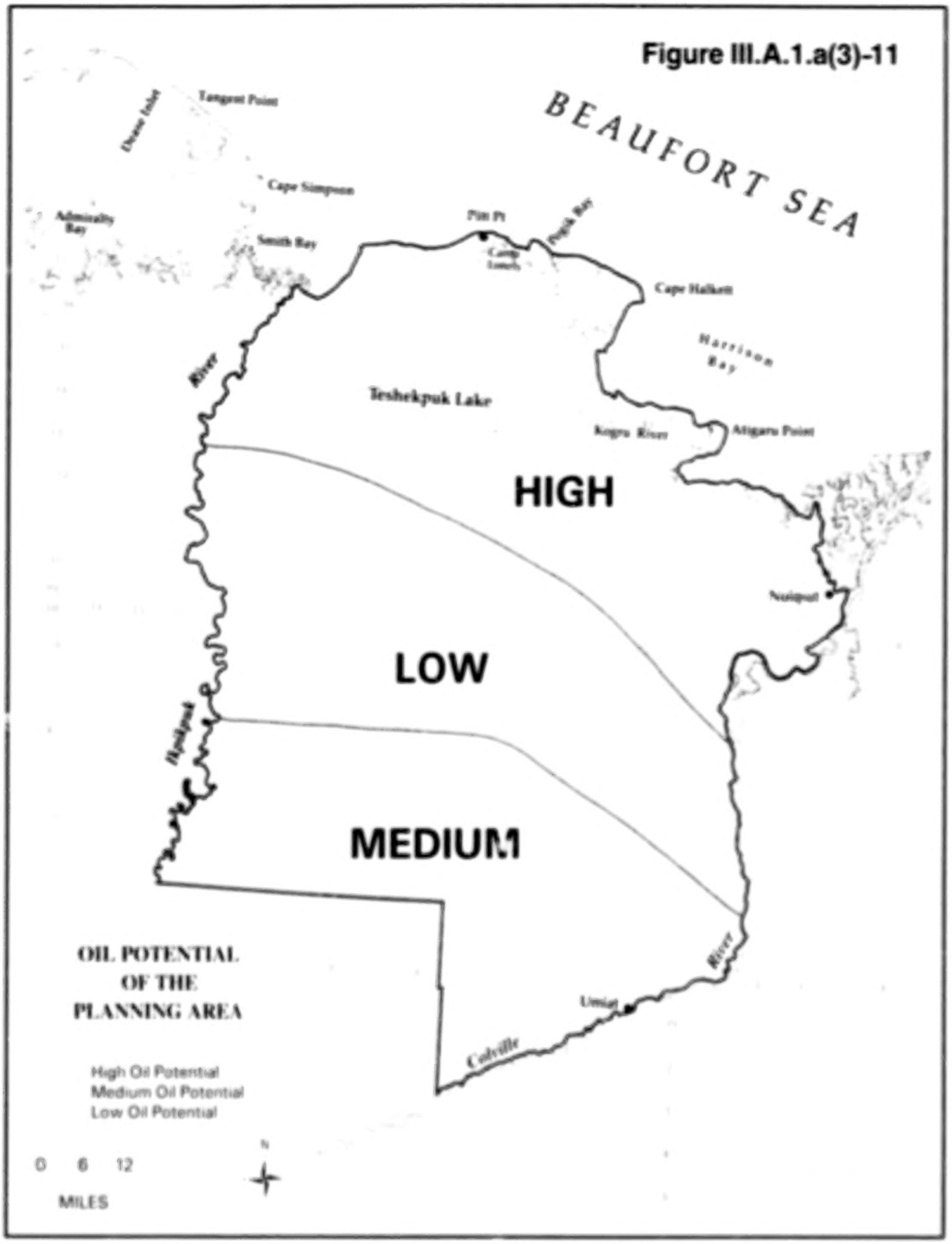


Figure III.A.1.a(3)-11

OIL POTENTIAL
OF THE
PLANNING AREA

BEST COPY AVAILABLE

energy prices. Note that the precision for oil volumes listed on Figure III.A.1.a(3)-9 was obtained from the PRESTO printout, not directly off this graph. The economic analysis concludes that if long-term *real* oil prices average $18 bbl, then 494 MMbbl of oil are economically recoverable from the planning area. At higher $30 bbl prices, 2.163 Bbbl are economically recoverable.

Comparing these economic results to the mean conventionally recoverable estimate (3.070 Bbbl) indicates that at current price levels ($18 bbl) only 16 percent of the recoverable geologic resources would be economic to produce, if discovered. In contrast, at the high price level ($30 bbl) 70 percent of the recoverable geologic resources could become commercial fields, if discovered. This clearly illustrates the controlling influence of commodity price on economic viability.

The contribution made by the 14 geologic plays to the economic totals is shown in Figure III.A.1.a(3)-10. A few plays contribute the majority of the economic resources, similar to the results of the geologic assessment. With respect to conventionally recoverable resource estimates, 3 plays (plays 6, 8, and 9) account for 77 percent of the total (Table III.A.1.a(3)-1). In the economic assessment, these same three plays account for 92 and 86 percent of the potential commercial resource base (at $18 and $30 oil prices, respectively). The Beaufortian plays (plays 8 and 9) are very important contributors to the resource potential of the planning area, accounting for 43 and 51 percent of the total economic oil volumes (at $18 and $30 oil prices, respectively). This analysis confirms previous conclusions by State of Alaska geologists regarding the Beaufortian potential in the NPR-A (Kornbrath et al., 1997). Of the secondary plays (plays 1 and 11), only the Endicott play has significant economic potential, contributing 8 and 10 percent to the economic totals (at $18 and $30 oil prices, respectively). Relatively small pool volumes and thin, low-performance reservoirs are probably responsible for the lack of economic potential in the Brookian plays.

Resource potential is not uniformly distributed in the planning area (Fig. III.A.1.a(3)-11). Resource potential is used here in a very broad sense, incorporating both geologic and economic potential. Combining the contributions from the assessment plays with their respective play areas indicates that >80 percent of the undiscovered geologic resources and >90 percent of the economic resources (all oil) are expected in the northern third of the planning area. This conclusion is consistent with the production experience on the North Slope. Correlative formations in the Ellesmerian (Sadlerochit and Endicott) and Beaufortian (Kuparuk) sequences have accounted for nearly all of the commercial production to date from the North Slope. The North Slope fields are associated with a prominent subsurface ridge, the Barrow Arch, which has been a focal point for regional hydrocarbon migration and entrapment (Fig. III.A.1.a(2)-1). In addition to favorable geology, the northern coastal plain in the NPR-A has favorable logistical characteristics, including (among others) relative proximity to existing infrastructure and access to staging areas located on the coast.

Gas resources were not modeled in the present economic analysis for several reasons. First, and most important, there is no transportation system to deliver natural gas from Arctic Alaska to outside markets. Under current conditions, the high costs of gas-production infrastructure (pipeline, liquefied natural gas (LNG) plant and marine terminal, fleet of LNG carriers) cannot be supported by either gas prices or market demand. Considering that huge volumes of gas reserves have already been proven on the North Slope (23 to 35 Tcf), it is highly unlikely that a smaller volume of undiscovered gas in the planning area could individually support the necessary gas infrastructure. If a future gas pipeline and LNG system is constructed, allowing North Slope gas production to proceed, the economic analysis of potential gas resources in the NPR-A should be re-evaluated.

(e) Summary of Assessment Results: The 1997 resource assessment of the planning area recognized 14 geologic plays, 3 of which consist entirely of gas reservoirs, and 11 of which consist of mixed oil and gas reservoirs. The assessment of *conventionally recoverable resources* indicates that total oil potential could range from 1,832 MMbbl to 4,732 MMbbl (95% and 5% probability levels), with a risked mean estimate of 3,070 MMbbl. Conventionally recoverable gas resources have a total potential ranging from 3.190 Tcf to 21.674 Tcf (95% and 5% probability levels), with a risked mean estimate of 9.852 Tcf.

Estimates of *economically recoverable resources* are highly dependent on price and engineering cost assumptions. At representative prices, the risked mean economically recoverable resource estimate ranges from 494 MMbbl ($18 bbl price) to 2.162 Bbbl ($30 bbl price). The economic resource fraction amounts to 16 percent of the total geologic resource potential recoverable at near-current prices ($18 bbl) and 70 percent of the total geologic resource potential recoverable at high prices ($30 bbl). Gas resources in northern Alaska are currently uneconomic because of the lack of a transportation system to outside markets.

The resource potential is not uniformly distributed in thenortheastern NPR-A, and a few geologic plays hold a large majority of the undiscovered resource potential. The highest geologic and economic potential lies in the northern third of the coastal plain associated with the subsurface Barrow Arch. This structural feature has been a focal point for regional oil and gas migration, and all currently producing fields on the North Slope are located on the Barrow Arch. The Barrow Arch trends northwest-southeast, roughly parallel to the present Beaufort Sea coastline, across northern Alaska. The high oil potential of the northern coastal plain in the NPR-A is generally recognized, and it is likely that future exploration activities will be concentrated in this area.

The results of the 1997 MMS/BLM assessment are more optimistic with respect to both geologic and economic resource potential compared to the 1995 USGS assessment of northern Alaska. Direct comparisons are impossible because the USGS study covers the entire North Slope and does not specifically report estimates for the northeastern NPR-A. For approximate comparisons, simple areal proportioning of resources in the USGS subareas (60% of Central Coastal Plain subarea; 10% of the Central Foothills area) can be used to scale resource potential in the planning area. Using this scaling method, the USGS assessment indicates that the area could hold 1.5 Bbbl of mean conventionally recoverable oil resources. The corresponding resource potential estimated by the 1997 MMS/BLM assessment is 3.1 Bbbl, or twice the USGS estimate. Economic comparisons follow the same pattern. Simple areal proportioning of USGS subareas yields economic resources of 401 MMbbl ($18/bbl) and 947 MMbbl ($30/bbl). The 1997 MMS/BLM assessment estimates are 494 MMbbl (23% higher at $18/bbl) and 2.162 Bbbl (2.28 times higher at $30/bbl). This method of resource estimation by areal proportioning is not rigorous, but it does offer some comparative insight into these two recent assessments of the northeastern NPR-A.

Perhaps the largest difference between past and present assessments is the recognition of a significant new play in Jurassic sandstone reservoirs (Beaufortian sequence), as revealed by the Alpine discovery. These newly discovered reservoirs mark a local change in Jurassic depositional environments within an interval known primarily to be a marine shale (Kingak formation). The geologic conditions that led to the Alpine accumulation could occur elsewhere in the northern NPR-A, as preliminary seismic mapping suggests that correlative rocks underlie most of the northern coastal plain. Alpine-like prospects will probably be difficult to identify using only seismic data, but these stratigraphic traps are likely to be the principal targets for future exploration in the northeastern NPR-A.

b. Physiography: Physiography can be described as the classification of large-scale landforms within a given area. The planning area contains two of the three primary physiographic regions of the NPR-A, those of the Arctic Coastal Plain and the Arctic Foothills of the Brooks Range Wahrhaftig, (1965).

The physical geography of the existing environment (especially physiography, topography, climate, and general geology) are described in the following references, the contents of which are summarized and incorporated herein by reference: USDOI, 1973, 1979, 1985, 1995; USDOI, BLM, 1979, USDOD, Dept. of the Navy, 1975; and USDOI, MMS, 1996a.

(1) The Planning Area: The NPR-A contains the most northern public land in the United States, approximately 23 million acres situated on the northwest corner of Alaska. Approximately 4.6 million of those acres are included in the planning area. While the NPR-A is situated between the western Arctic (identified by place names like the Lisburne Peninsula, Point Lay, and Icy Cape) and the central Arctic (identified by the Colville River and Prudhoe Bay), the planning area is bounded by the Ikpikpuk River and an artificial line narrowing south of the Ikpikpuk on the west side, while using the NPR-A boundary on the east (Colville River, Nuiqsut), north (Beaufort Sea), and south (Colville River, Umiat).

(2) The Arctic Coastal Plain Province: The Arctic Coastal Plain covers approximately 85 percent of the planning area and is part of the same plain system that makes up the Great Plains. Like the Great Plains, it is a broad, level area that is <1,000 ft in elevation. The main difference between the two plains that the Arctic Coastal Plain is dominated by periglacial features, which include countless thaw lakes, marshes, and patterned ground. Patterned ground forms from ice wedges that freeze within the contraction cracks of the soil. Throughout the year, these cracks fill with water and snow, then freeze and expand. During the warmer months, the ice melts and water remains. This process repeats annually, which results in the ground becoming polygon patterned. Permafrost underlies nearly 100 percent of the planning area.

Describing particular areas of the coastal plain in more detail, beginning at the coast and working south, the beaches and islands of the area have little vegetation with prevailing northeast winds and frequent ice buildups. The bluffs above the ocean generally are 10 ft high except where barrier islands protect the main shoreline. There are mudflats found within the planning area at Pogik Bay and near the Nechelik Channel of the Colville River. Pogik Bay and other smaller bays along the coastline appear to be old thaw lakes that have since connected with the Beaufort Sea. The Kogru River is another place in the coastal area where thaw lakes apparently have joined together to form a bay about 18 mi long.

From the coast, the Arctic Coastal Plain extends south approximately 30 mi into the coastal lowlands. The lowlands are characterized as a vast, treeless area of tundra vegetation, meandering streams, drained and undrained lagoons, as well as thousands of shallow thaw lakes that dominate the landscape. These thaw lakes are all oriented to the northwest due to the erosive wave action caused by the predominant northeast wind direction. For this reason, thaw lakes generally are greater in length than in width and usually very shallow. Thaw lakes cover between 50 and 75 percent of the coastal plain and occur somewhat in the foothills region (USDOI, BLM, 1979). Teshekpuk Lake, the third largest freshwater lake in Alaska (USDOI, BLM, 1979), is drained to the Beaufort sea via the Miguakiak and Ikpikpuk rivers. Another noteworthy drainage in this area is Fish Creek, which is situated on the northeastern side of the plain and is notable for its subsistence resources.

The lake-filled coastal plain fades into an area of large rounded lakes and myriad very small lakes at an elevation of around 100 ft (roughly 40 mi inland). Dunes and ridges, such as the Pik Dunes, appear. At an elevation of 200 ft, more defined streams begin to replace the smallest of lakes (about 60 mi inland). The bluffs along the Colville appear at an elevation of about 150 ft and are well defined in this area.

(3) The Arctic Foothills Province: The Arctic Foothills Province becomes pronounced at about 90 mi inland and south of the coast. Elevations here start at around 500 ft. While the Arctic Foothills Province extends to the Brooks Range (about 180-200 mi), the planning area boundary is the Colville River at about 120 mi south of the coast.

This physiographic unit consists of tundra-covered rolling hills, low east-west-trending ridges, as well as occasional small pingos. The highest elevation within the planning area is 1,150 ft, which is just southeast of Square Lake. Other notable features in this area include Umiat Mountain and Shivugak Bluff.

The Colville River is the southern boundary of the planning area. It also is the longest river in the Arctic Foothills Province at 220 mi long. Lakes in the area become fewer and deeper. Although there are no glaciers, the area is underlain by continuous permafrost. Ice wedges, stone strips, polygonal ground, solufluction lobes, and other permafrost features are present.

(4) The General Area: The surficial deposits of the NPR-A generally are fine-grained deposits of clay, silt, and sand. Gravel is scarce and confined to riverbeds and the southern mountains. Sand dunes are common and stabilized by vegetation. It is generally agreed that the area North of the Brooks Range was not glaciated during the Pleistocene epoch; however, glacial-eroded material was transported north out of the mountains to the coastal areas to be deposited by wind and streams. There are many vertebrate-animal remains frozen in the soils of the Quaternary period.

The NPR-A lies above the Arctic Circle, and because the climate is Arctic, it is characterized by long winters, days of little sunlight, cold temperatures and very dry air. The summers short, with long hours of sunrise, fog, and few days with temperatures above freezing per year. Freezeup begins in early to mid-September each year, while breakup occurs in June. The prevailing winds are from the east, however, they shift to westerly from January through April.

The soils are perennially frozen (permafrost), and this is a major element in economic development and environmental concern in the region. The active (thaw) layer extends to no more than 2 to 4 ft in the NPR-A as a whole. The frozen layer below does not allow for vertical drainage. The lack of relief in the coastal plain areas slows horizontal drainage creating a boggy, swampy surface overlying an area of frozen ground reaching 1,000 ft at Barrow and 2,000 ft at Prudhoe Bay.

Construction in the area uses techniques such as constructing on pilings or using cooling devices or by following seasonal restrictions to minimize the amount of heat transfer to the permafrost layer.

c. Soils: The information contained in this section was extracted from the appropriate parts of the document *Exploratory Soil Survey of Alaska* (Rieger, Schoephorster, and Furbush, 1979).

The exploratory survey was initiated in 1967 and was completed in 1973. Field mapping was done at a scale of 1:500,000 (about 8 mi=1 in). All existing soil maps and reports were used, but the exploratory soil map was based largely on observations made from a small helicopter that landed frequently in roadless areas for onsite soil identification. Distinctive landscape patterns were identified from the air and delineated on the map. Soils within each landscape segment were described and classified; relationships between the soils, the native vegetation, and landforms were noted; and the proportion of the area occupied by each major kind of soil was estimated. In essence, each map unit in this survey was an association of soils arranged in a consistent pattern.

(1) Major Land Resource Areas: Two major land resource areas (MLRA's) have been recognized in the planning area. See Figure III.A.1.c-1 for locations of MLRA's in the planning area. Each MLRA is characterized by a unique pattern of topography, climate,

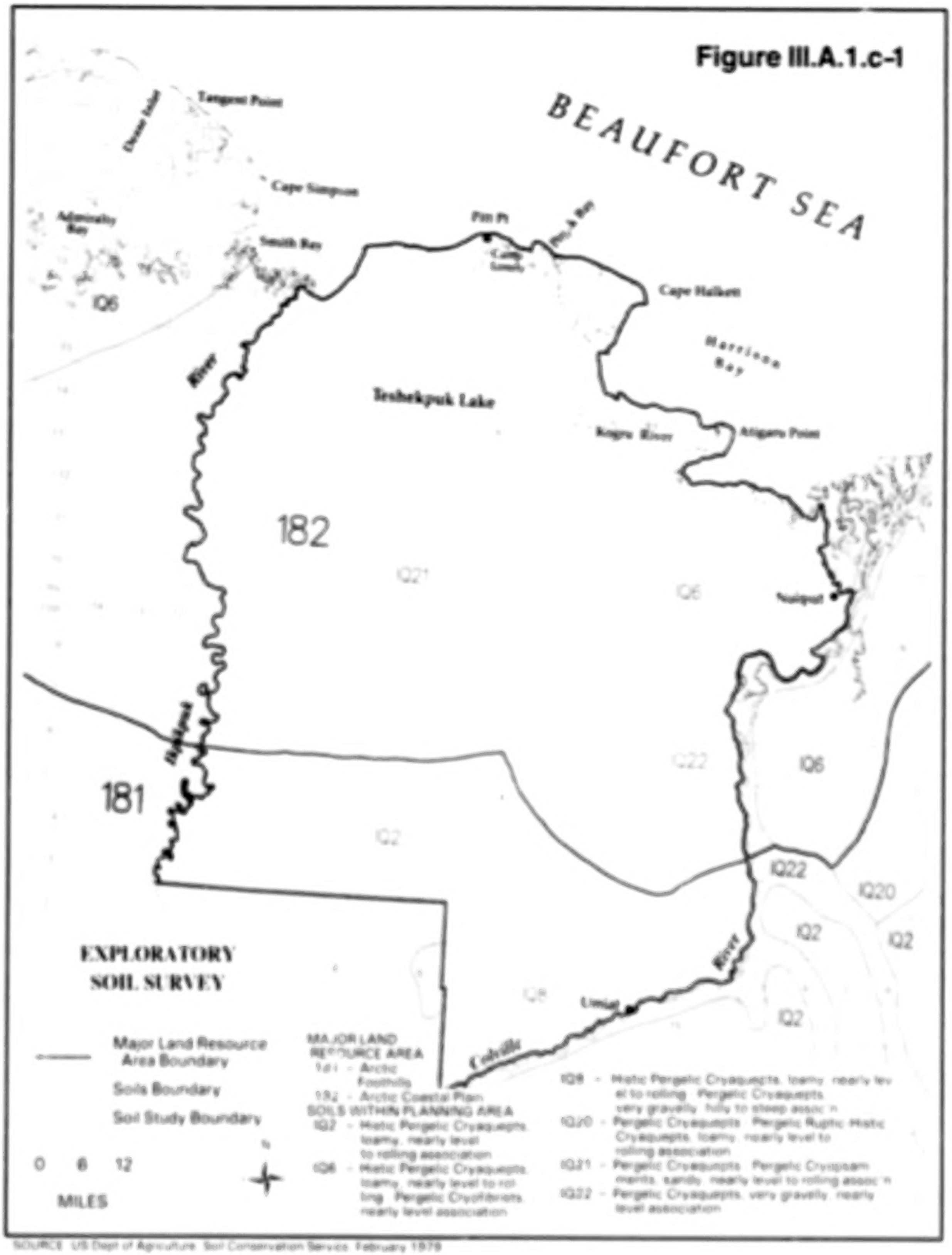


Figure III.A.1.c-1

BEAUFORT SEA
Tangent Point
Dease Inlet
Cape Simpson
Admiralty Bay
Smith Bay
Pitt Pt
Pitt Pt Bay
Camp Lonely
Cape Halkett
Harrison Bay
Teshekpuk Lake
Kogru River
Atigaru Point
Nuiqsut
River
Ikpikpuk
Colville River
Umiat
181
182
IQ6
IQ21
IQ6
IQ22
IQ6
IQ2
IQ22
IQ20
IQ2
IQ2
IQ8
IQ2
EXPLORATORY SOIL SURVEY
Major Land Resource Area Boundary
Soils Boundary
Soil Study Boundary
0 6 12
MILES
N
MAJOR LAND RESOURCE AREA
181 - Arctic Foothills
182 - Arctic Coastal Plain
SOILS WITHIN PLANNING AREA
IQ2 - Histic Pergelic Cryaquepts, loamy, nearly level to rolling association
IQ6 - Histic Pergelic Cryaquepts, loamy, nearly level to rolling; Pergelic Cryofibrists, nearly level association
IQ8 - Histic Pergelic Cryaquepts, loamy, nearly level to rolling; Pergelic Cryaquepts, very gravelly, hilly to steep assoc'n
IQ20 - Pergelic Cryaquepts; Pergelic Ruptic Histic Cryaquepts, loamy, nearly level to rolling association
IQ21 - Pergelic Cryaquepts; Pergelic Cryopsamments, sandy, nearly level to rolling assoc'n
IQ22 - Pergelic Cryaquepts, very gravelly, nearly level association

SOURCE: US Dept of Agriculture, Soil Conservation Service, February 1979

BEST COPY AVAILABLE

116

vegetation, and soils. The areas are the Arctic Foothills and Arctic Coastal Plain (Sec. III.A.1.b).

(2) **The Soil Classification System**: The Soil Taxonomy of the National Cooperative Soil Survey, adopted in 1965 defines soils by their properties rather than by external environmental factors such as climate and vegetation. In the *Exploratory Soil Survey of Alaska* (Rieger, Schoephorster, and Furbush, 1979), the soils of Alaska were classified at the subgroup level and placed in distinct map units. Five map units occur in the planning area; Figure III.A.1.c-1.

(a) **Map Unit IQ2**: This unit in the Northeast NPR-A Planning Area occupies most of the northern part of the Arctic Foothills, and it is extensive and widespread in all regions of the permafrost zone. Although the dominant soils have similar characteristics, there are some differences in associated soils of relatively minor extent, soil patterns, landforms, and landscape features. Largely because of ice-rich permafrost, the dominant soils in all areas of the unit have severe limitations for any intensive use and development. This unit occupies broad valleys, basins, foot slopes, and low rolling piedmont hills. Most areas are patterned with polygons, stripes, and some circular frost scars. Elevations range from about 300 ft above sea level near the coastal plains to 3,000 ft on foot slopes of the Brooks Range. Most of the soils consist of silty colluvial and residual material weathered from fine-grained, nonacid sedimentary rocks. The vegetation consists of tundra dominated by sedges, mosses, lichens, and low shrubs.

(b) **Map Unit IQ8**: This unit occupies most of the southern part of the Arctic Foothills on the hills and ridges of the planning area. The unit occupies extensive parts of the foothills north of the Brooks Range. Broad sloping valleys separated by steep ridges, hills, and knolls dominate the landscape. Elevations range from near sea level on a few foot slopes to about 3,000 ft on hills and ridges near the Brooks Range. All areas are underlain by permafrost. The dominant soils in valleys and on long foot slopes formed in loamy colluvial sediment. On hills and ridges, most of the soils consist of very gravelly material weathered from sedimentary rock. A few soils near the Brooks Range formed in very gravelly glacial drift. The vegetation consists of tundra made up of mosses, sedges, lichens, grasses, dwarf shrubs, and small forbs. Long slopes commonly have a striped vegetative pattern, and many frost-scarred areas occur on hills and ridges. A few windswept peaks are nearly bare. The soils have severe limitations for intensive use and development. The vegetation is used by caribou and other wildlife and is suitable for reindeer grazing.

(c) **Map Unit IQ6**: This unit occupies most of the eastern part of the Arctic Coastal Plain in the planning area. With few exceptions, the soils of this unit are shallow over permafrost and are constantly wet. This unit occurs on the nearly level to rolling Arctic Coastal Plain bordering the Arctic Ocean. Elevations range from sea level to about 400 ft. This treeless area is characterized by many small thaw lakes. Low terraces; broad, shallow depressions; and floodplains are typical of the landscape. Frost features, including polygons, hummocks, frost boils, and pingos, are common. Thick permafrost underlies the entire area. The dominant poorly drained soils have developed principally in deep, loamy sediment under a thick cover of sedge tussocks, low shrubs, forbs, mosses, and lichens. Very poorly drained fibrous peat soils occupy broad depressions, shallow drainageways, and lake borders, commonly under a thick cover of sedges. Soils of this association are cold and wet. Most of them have very severe limitations as sites for most types of construction. Caribou and a few moose, wolves, and small furbearers use this area. It is a major nesting ground for migratory birds.

(d) **Map Unit IQ21**: This unit occupies most of the western part of the Arctic Coastal Plain in the planning area. The landscape is dominated by nearly level low tundra dotted with shallow thaw lakes. There are many undulating and rolling sand dunes, especially in areas bordering the floodplains of major streams and some of the larger lakes. Most of the dunes are stabilized by vegetation, though some dunes adjacent to streams are active. Elevations range from a few feet above sea level near the coast to about 150 ft in areas farther inland. The vegetation is arctic tundra dominated by sedges, mosses, grasses, lichens, and low shrubs and forbs. Most of the soils in the association consist of sandy eolian, alluvial, and marine deposits, but a few formed in loamy material. Poorly drained soils with a shallow permafrost table occupy most of the nearly level areas and the broad swales between dunes. The soils on dunes consist of eolian sand and, although they are perennially frozen below a depth of 30 to 40 in, they seldom retain enough moisture for large ice crystals to form. The permafrost imposes severe limitations on construction activities. Soils of this unit provide wildlife habitat for species that frequent the arctic tundra, including migrating herds of caribou and nesting waterfowl. The area potentially is suitable for reindeer grazing.

(e) **Map Unit IQ22**: This unit occupies much of the area along the Colville River through both the Arctic Foothills and Arctic Coastal Plain. This unit occupies low terraces, braided floodplains, and broad alluvial fans bordering the Colville River. Elevations range from sea level on plains bordering the coast to about 2,000 ft in the Brooks Range. The dominant soils consist of very gravelly stream deposits underlain by permafrost. Low parts of the unit are commonly flooded by runoff from spring snowmelt and heavy summer rainstorms in the mountainous watershed areas. The vegetation consists of arctic tundra dominated by sedges, mosses, and low shrubs. Soils of the association provide habitat for wildlife that frequent the arctic tundra and are potentially suitable for reindeer grazing. Most of the soils have severe limitations for construction, but well-drained very gravelly soils of minor extent that occur near escarpment edges on low terraces, slightly above the floodplains, are among the most suitable soils for building sites, roads, and other intensive uses in the Arctic.

d. Sand and Gravel: The sand and gravel resources and construction techniques relevant to oil and gas exploration and other construction projects in the NPR-A are described in the following documents: *Engineering Considerations for Gravel Alternates in NPR-A* (USDOI, BLM, 1981); *An Environmental Evaluation of Potential Petroleum Development of the National Petroleum Reserve in Alaska* (USDOI, USGS, 1979); and *The National Petroleum Reserve in Alaska, Earth Science Considerations* (USDOI, USGS, 1985). A summary of the description, augmented by additional material, as cited, follows.

(1) Materials: The surficial deposits of the northern portion (Arctic Coastal Plain Province) of the planning area are composed of Gubik formation marine sands and silts with depths of 20 to 180 ft. The underlying rock of the Colville and Nanushuk Groups ranges from sands to shales. Gravels in this portion of the planning area are found associated with river systems.

The surficial deposits of the southern portion (Arctic Foothills Province) of the planning area are composed of eolian sands and silts. The underlying rock in this case is an undifferentiated bedrock of sandstones, shales, and conglomerates. The bedrock is exposed in the southern quarter of the planning area. Gravel resources are associated again with river systems.

The presence of large amounts of ice in the soils and underlying materials of the planning area make mineral materials difficult to use. When heated, ice-rich silts slump and collapse. Sand and gravel found in permafrost areas may contain large amounts of ice but still provide substantial strength on thawing.

(2) Regulatory Environment: There was concern as early as 1974 (USDOD, U.S. Army Corps of Engineers [COE], 1974:123) that in certain areas of the Arctic Coastal Plain, sand and gravel resources would become scarce. This concern is reflected in the National Petroleum Reserve Production Act (NPRPA). Because sand and gravel have economic value, BLM regulations (43 Code of Federal Regulations [CFR] 3600) provide for the sale of mineral materials defined generally as common varieties of sand, stone, gravel, clay, etc.

Sand and gravel in the NPR-A are treated as subsurface-mineral resources. Mineral-material resources are not conveyed with the surface lands as is the norm in other areas of the State. Until the recent transfers of subsurface estate, i.e., Nuiqsut subsurface to Arctic Slope Regional Corporation (ASRC), the Federal Government controlled all mineral materials in the NPR-A. The BLM has issued mineral-material permits to the four villages/cities of the North Slope Borough (NSB) for dredging sand and gravel as part of the NSB's Capital Improvement Projects (CIP) in the 1980's. Nuiqsut dredged material from the Colville River bottom, while Atqasuk used material from the Meade River and the bottom of an adjacent lake. River- and ocean-beach materials were used in the 1970's to 1980's for wellsite-pad and -road and -airfield construction.

(3) Engineering Techniques: The NPR-A exploration program of 1975 to 1982 involved not just oil and gas exploration but also engineering research programs related to construction in the Arctic. This time period reflected an interest in cold regions mineral development (hardrock and coal as well as oil and gas and sand and gravel) worldwide. Techniques have developed as alternates and supplements to the use of sand and gravel. These techniques include the use of pilings, insulated pads, geotextiles, elevated or reinforced pads, ice pads, and roads. The U.S. Army Cold Regions Research Laboratory, an early engineering contributor and researcher, continues to monitor sites in the NPR-A for long-term changes.

Mineral materials along beaches are a source used in the past. Depending on the specific needs and location, extraction might be able to occur with minimal concern. Mineral materials found in relation to streams and rivers in some instances might be able to use the flowing water to recharge extracted material or, in other instances, the waters might be too important for fishery needs to disturb. Mineral materials might be found elevated on ridges and hillsides in the mid- to southern section of the NPR-A.

Filling of pits is difficult, as the presence of water in a pit or the simple removal of the natural surface insulating vegetative mat can cause the pit to deepen over time. Material removed from the pit reduces in volume as ice melts out, and so it may take much more material to fill the pit as came out of it. Experience suggests that it is better to design the pit to conform to natural features, reclaim what material is available, and allow the pit to remain.

e. Paleontological Resources: Most of the NPR-A is underlain by sedimentary rocks. As a result, the NPR-A contains a wide array of plant and animal fossils.

The earliest fossil reported from the NPR-A is the tooth plate of a lungfish found in Middle Devonian rocks about 380 million years old (Lindsey, 1986). Most subsequent rock formations in the NPR-A exhibit some form of fossil record.

Most of the limestone, sandstone, siltstone, and shale that underlies the NPR-A is marine in origin, and the fossils reflect this. By far, the most common fossils are brachiopods, cephalopods, gastropods, pelecypods, sponges, bryozoans, corals, and crinoids. It is in the middle part of the Jurassic Period, roughly 160 million years ago, that the first evidence of terrestrial plant fossils are noted—an indication of at least a temporary retreat of the ancient seas that previously had covered most of the region. Following this, the seas repeatedly advanced and retreated over most or all of the NPR-A.

One-hundred-million-year-old lower Cretaceous rocks in the NPR-A produce some of the best examples of the flora of that period found anywhere in North America (Lindsey, 1986). These plant fossils also document a change from a warm to a cool climate. It is at this time that modern conifers begin to appear on the North Slope.

Late Cretaceous vertebrate fossils dating from 70 to 65 million years ago also are common. One of the most significant world-class dinosaur finds of the last 50 years lies within the planning area on the left bank of the Colville River at Ocean Point. It is the farthest north occurrence of dinosaurs in North America. Data gathered through research at this site has challenged long-held theories concerning dinosaur physiology and extinction (Brouwers et al., 1987; Paul, 1988; Clemens and Nelms, 1993). Most of the bones at Ocean Point are beautifully preserved with varying degrees of mineralization. Some exhibit few void fillings and approach the low density of nonpermineralized (petrified) bone. The bone often is encapsulated with iron oxide, sulfide, and quartz. This unusual preservation and entombment in permafrost offers the possibility of DNA and other biomolecular extraction heretofore unattainable in fossils this ancient (Gangloff, 1997).

Tertiary (65-1.6 million years ago) fossils are represented primarily by mollusks, ostracods, brachiopods, and bryozoans, although the record is incomplete due to a period of nondeposition and/or erosion that occurred during the Late Tertiary (Lindsey, 1986).

Fossil remains from 20,000 to 10,000 years ago, the latest portion of the Pleistocene (the last Ice Age), also are abundant in Quaternary deposits across the planning area (Hamilton and Ashley, 1993; Guthrie and Stoker, 1990). The bones of horses, camels, mammoths, and bison are a resource of important data regarding the climate, environment, and ecosystem that existed when the first humans entered the Western Hemisphere from the Old World (Kunz and Mann, 1997). Primary sources for these fossils in the planning area are the Ikpikpuk and Colville drainages.

Most of the paleontological resources in the NPR-A are, by virtue of their isolation and remoteness, protected from most types of impact other than those caused by natural forces. The bulk of the deposits are deeply buried and the landscape covered by snow and frozen 9 months of the year and, therefore, adequately protected by nature. However, most of the major known deposits are vulnerable in that they are most often exposed in an eroding bluff face. In fact, most paleontological deposits in the area would not be discovered if it were not for these exposures. However, the circumstance that led to discovery also allows unauthorized collection and the loss of valuable and important scientific and educational material. Most exposed bluff faces are formed through the erosional activity of rivers and streams. Fossils commonly are exposed or washed out of these bluff faces during annual high-water events. Even in a place as remote as the NPR-A, a river may allow access by boat or by small aircraft, which can land on gravel bars. Currently, unauthorized collection occurs at several locations in the planning area. Unauthorized collection is best deterred by a visible presence such as active research rather than irregular law-enforcement patrols (Gangloff, 1997).

These paleontological resources are nonrenewable and contain a wealth of information about lifeforms, geography, and environments of the past and must receive adequate protection. Most of the paleontological resources of the NPR-A are yet to be located, and work toward that end is another important step in the protection of this resource.

f. Oil and Gas Exploration—Environmental Status:

(1) Background: Energy minerals within the NPR-A include oil, gas, and coal. Although coal is a major occurrence west of the planning area, there is no known current research, exploration, or use of coal inside the planning area. Some oil and gas opportunities exist in the NPR-A, and exploration has occurred throughout the reserve, with the major current interest in the northeast portion (DM3).

There are four distinct time periods of administration and mineral exploration in the NPR-A, including: (1) an early period (pre-1923), (2) the Navy period (1923-1976), (3) the Department of the Interior period (1976-1980), and (4) the private period (1981-present).

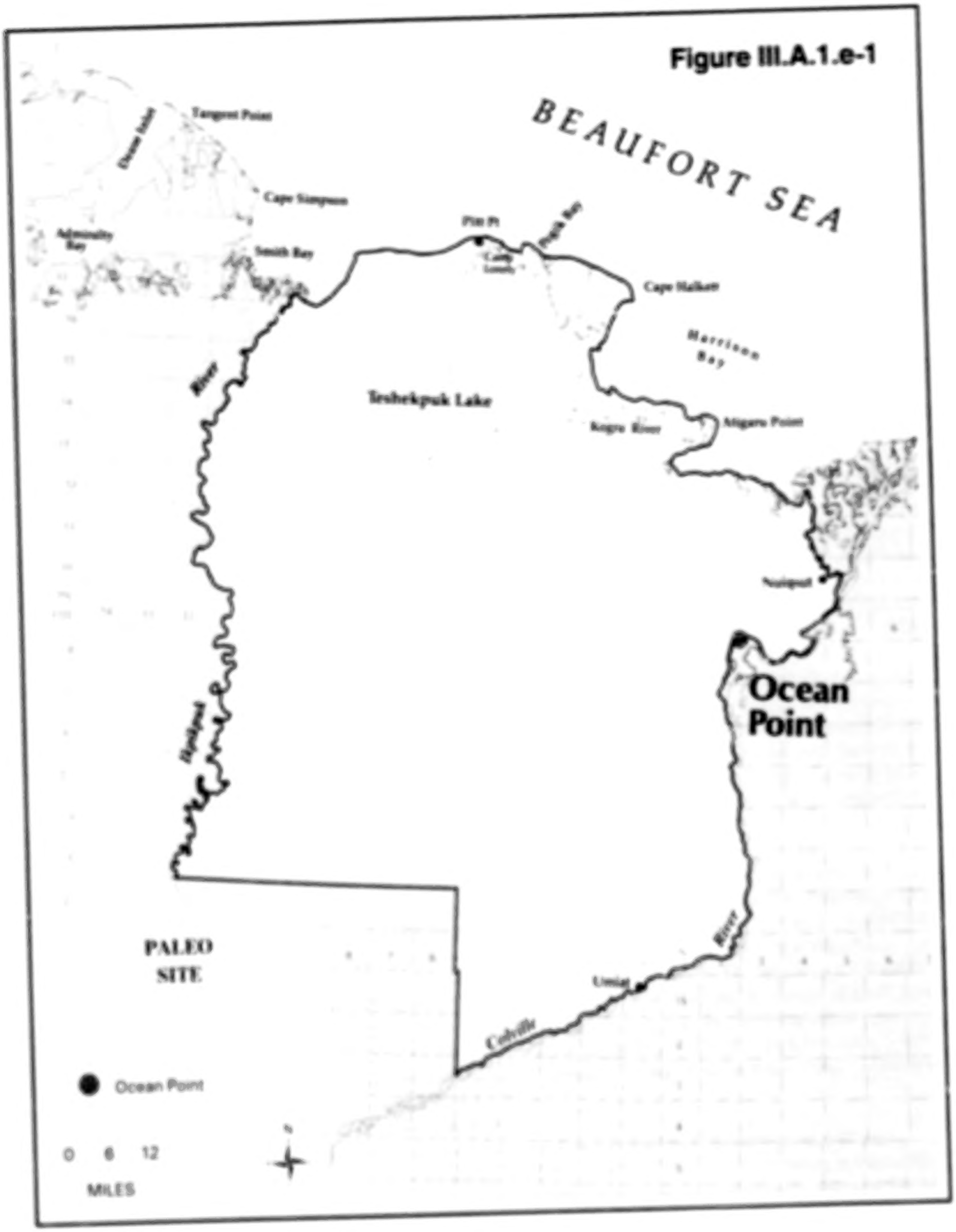


Figure III.A.1.e-1

BEST COPY AVAILABLE

(a) The Early Period: The first period and earliest "exploration" also is the most primitive. The period begins with Native people's use of oil seeps and ends with the establishment of Pet-4 in 1923. There are no known physical traces of local use; however, use appears in the oral tradition where oil seeps were harvested for an oil-soaked sod, or "pitch."

The local population has required the use of various fuels beyond marine mammal oils and driftwood for at least the last 100 years. With the introduction of the metal stove, the use of hotter burning fuels such as coal and hardened petroleum also called "pitch" from oil seeps became possible (Libbey, 1988-89:513).

By the time the Barrow Native Store opened in 1921, kerosene and gasoline were available for lanterns and some coal and later some hardened petroleum from an oil seep to the east were available for heating and cooking (Libbey, 1988-89:513).

> And later on, back in the '30s, they started to let people go out to the pitch lake out here at Tulimaniq (Barrow TLUI Site #140) and cut up those in blocks and put it in gunny sacks and haul it down to the beach for the Native Store . . it is the seepage of the oil that surfaces and spreads out. As time goes by it hardens. So they cut it in blocks before the snow goes away (Libbey, 1988-89:514).

Reports between 1919 and 1921 developed by the USGS and other Government agencies noted oil seeps on Smith Bay (Cape Simpson) and concluded that there may be petroleum at many places in the Arctic Coastal Plain, and that possibly there may be a more-or-less continuous oil-bearing belt extending across northern Alaska (Martin, 1921).

Prior to the Mineral Leasing Act of 1920, numerous oil and gas mining claims were located on the North Slope in what is now the NPR-A. Roughly 117 claims were staked before the establishment of the reserve. The General Land Office, which became the BLM in 1946, issued Prospecting Permits for the claims that expired 10 years from approval. There are no records of any exploration under these claims. Several of the claims, along the south end of Teshekpuk Lake, were staked inside the planning area.

(b) The Navy Period: The Navy began oil and gas exploration in the reserve in 1944. Between 1944 and 1952, Naval exploration sites were simple in design. A site was prepared, a drill rig erected, and drilling commenced. Today, the Navy site conditions generally consist of a pipe surrounded by natural vegetation. All of the Navy sites currently are in need of completion (reclamation, abandonment, plugging, or other tasks). The bulk of material left after Navy operations ceased was cleaned up by the USGS and its contractors beginning in 1976.

Between 1975 to 1976, the Navy began a more modern exploration program, which is conceptually described in the *FEIS for Continuing Exploration and Evaluation of NPR-4 (Zone "A")* (USDOD, Dept. of the Navy, 1975). The NPRPA passed responsibility for the program to the Department of the Interior (DR5).

(c) The Department of the Interior Period: The Department of the Interior was charged with exploring the NPR-A between 1976 and 1982. The Secretary of the Interior appointed the USGS the responsible party for the exploration program under Section 104 of the NPRPA. The USGS contracted for exploration operations with Husky Oil Company. The wellsites generally were composed of a camp pad, drilling pad (normally all one pad), reserve mud pit, a flare pit, a fuel storage pit, the well head consisting of a pipe (Christmas tree) surrounded by the cellar (corrugated metal chamber or timber cribbing), and sometimes an airstrip with access road. Drilling operations in areas of unknown underground pressures may use pits to allow for a safe way to redirect escaping petroleum. In addition, the pits received expended drilling muds. The USGS Husky exploration operations ended in 1981. The USGS began continuous wellsite cleanup and rehabilitation beginning in 1978.

Today, there are 28 wells under USGS jurisdiction. All of these wells have been cleaned of visible debris and revegetated. Valves have been left on the wells in lieu of surface plugs to allow for continuing research.

(d) The Private Period: Private exploration began with the passage of the Interior Appropriations Act of December 1980. An oil and gas leasing program was initiated, with the first sale in 1982. One well (Brontosaurus) was drilled by a private company through the leasing program. The Cape Halkett land exchange transferred to the Arctic Slope Regional Corporation (ASRC) the W.T. Foran well and allowed the ASRC to drill the Livehorse well on private land within the overall boundary of the NPR-A. Wells in the Barrow area (such as the South Barrow Gas field and the Walakpa exploration wells) developed by the Federal Government through the Barrow Gas Field Transfer Act are owned by the North Slope Borough as part of its natural gas production program.

Modern well designs generally call for recirculating mud systems without pits. The disturbed area is minimal. Modern completed wells under any future leasing should

BLANK PAGE

appear very much as Brontosaurus—a closed pipe marks the location, and there is little else visible; the ground area has a natural appearance. Included in this time period are the permitted seismic operations. All private seismic operations in the NPR-A have used vibrating equipment rather than explosives, and all have gained from the considerable experience of the NPR-A Government-exploration programs.

(2) Framework for Exploration-Site Jurisdiction: Executive Order of 1923 (E.O. 3797-A) created Pet-4 by withdrawing the Arctic Coast's west-central public lands roughly between Icy Cape on the west and the Colville River on the east down to the crest of the Brooks Range for the use of the U.S. Navy in its quest to secure oil and gas reserves for the expected conversion of the Navy from coal to oil. The wells of the Navy period remain a military site-cleanup responsibility.

The NPRPA created the NPR-A and authorized the Secretary of the Interior to split management of the NPR-A between BLM (surface) and the USGS (subsurface). The USGS had surface and subsurface management authority for all work within "Areas of Operations." These decisions were consistent with the Secretarial Orders of the time and with oil and gas activities in other parts of the country. Responsibility for final closeout of the NPR-A Areas of Operations remains with the USGS.

Two agencies normally deal with wellsite "closure," the State of Alaska, Dept. of Environmental Conservation (ADEC) and the land manager/owner (BLM). The ADEC is the regulator for closure of reserve/mud pits and the disposal and/or removal of solid and hazardous waste. The BLM has a dual role regulating completion of the well (including plugging and abandonment) and as the land manager.

The BLM State Director for Alaska and the USGS Assistant Director of Engineering Geology signed a Project Charter in 1992 that included the objective ". . . for USGS and BLM to jointly determine the most prudent approach to future management of the sites. . . ." An assessment prepared in December 1992 (*Environmental Status of 28 Oil and gas Exploration Areas of Operation in the National Petroleum Reserve-Alaska*, pp. 14-15) notes a risk determination for each of the USGS wells. All wells are noted as either "no basis for concern" or "negligible" in terms of risk.

The BLM and USGS jointly asked the ADEC for pit closure. The ADEC provided approval for closure of 27 wellsite pits "as is." East Teshekpuk is conditionally closed, requiring a plan for trash uncovered by lake erosion and alternative plans for stabilizing exposed drilling muds. The ADEC also required a 5-year monitoring program to ensure that drilling muds are not released.

(3) Continuing Work of Researchers: The USGS is continuing geothermal research in Alaska that began over 40 years ago. This research requires lowering a thermistor inside a well case to log temperatures at various depths. The boreholes are periodically relogged by the USGS. Currently, 21 NPR-A wells are accessible. One Arctic Team member has worked with the USGS crew for the last 8 years of this project (Clow, 1996, pers. comm.).

The wells continue to be examined by the University of Alaska, Palmer Research Station to understand the revegetation process and to provide assistance with future revegetation efforts.

g. Hazardous Material:

(1) General Characterization of Hazardous and Solid Wastes in the Northeast NPR-A Planning Area Environment: In general, the planning area is large and has had relatively limited human or industrial uses that may have introduced hazardous or solid wastes into the environment. Industrial activity consisted of USDOD sites, including the Distant Early Warning (DEW) Line stations to provide military satellite and coastline surveillance; oil and gas drilling programs conducted by the U.S. Navy and the USGS; and winter petroleum seismic-exploration operations conducted under permit by private companies. Incidental use by the local Native population for subsistence hunting, fishing, and travel potentially may have created additional solid and fuel waste on a small scale.

Generally, the area of operations for the abandoned well sites contains a drilling pad and reserve and flare pit. In some instances, other solid waste may have been buried at these sites. There were different configurations of pad design, construction, and rehabilitation for the well sites located within the planning area. Wastes for these sites are classified as solid wastes under 40 CFR Part 261.4(b)(5).

Site characterizations were conducted by a joint BLM/USGS effort at the 28 USGS well sites in the NPR-A, 14 of which are located in the planning area. Detailed information concerning the contaminants found at each well site, data summarization, and USDOI publication titled *Environmental Status of 28 Oil and Gas Exploration Areas of Operation in the National Petroleum Reserve-Alaska*. Additional discussion can be found in the oil and gas exploration section (Sec. 3.a.1.f).

Solid-waste landfills have been associated with virtually all of the drilling sites and USDOD sites. Site investigations have been conducted by the USDOD at all 20 sites located along the Arctic Coastal Plain. Three of these sites are located within the planning area: Camp Lonely, Kogru DEW Line Station (abandoned), and Umiat Airport (abandoned). Contamination, including petroleum, oils, and lubricants (POL's), polychlorinated biphenols (PCB's), and pesticides (specifically DDT) were identified at Umiat and Kogru. Remedial actions currently are being conducted by the U.S. Army COE to excavate or cap contaminated soils and to remove unsafe structures at these abandoned sites.

Commercial uses of the planning area have included winter overland transportation services along established trail corridors servicing North Slope communities. Fuel and POL spills may have occurred in the past as a result of these activities. Currently, all travelers are responsible, under State law, for adequate prevention of spills and for prompt notification and cleanup should a spill occur.

Other uses identified within the planning area include research and field-management activities by resource staffs within the BLM, USGS, Fish and Wildlife Service (FWS), Alaska Department of Fish and Game (ADF&G), Alaska DNR, and the NSB. Other research activities have been conducted through the University of Alaska, Fairbanks, and by UIC and the ASRC. These uses generally have involved short-term camping and helicopter flying. No fuel spills or unauthorized solid-waste dumping have been identified as a result of these research or field-management activities.

(2) Distribution and Numbers of Sites Within the Planning Area: The numbers and types of sites within the planning area are two hazardous-materials sites, six solid-waste-disposal sites, and numerous well sites (see Fig. III.A.1.f-1 for all identified past or present spill or drilling sites).

Hazmat Sites:
Kogru DEW Line site
Umiat Airport (on State and Federal lands)

Solid-Waste-Disposal Sites:
East Teshekpuk landfill
lat. 70°34' N., long. 152°56' W.
Debris
Gubic (gas-drilling site, 1951)
lat. 69°25' N. long. 151°26' W.
Debris: 2,500 barrels, 20 tons of metal and wood
Mona Lisa (exploration site)
lat. 69°55' N. long. 154°22' W.
Debris: 500 barrels
Square Lake (oil-drill site, 1952)
lat. 69°35' N. long. 153°15' W.
Debris: 2,000 barrels
Wolf Creek (gas-drill site, 1951)
lat. 69°23' N. long. 153°16' W.
Debris: 1,950 barrels and metal and wood
POW-B (Kogru DEW Line site)
lat. 70°03' N. long. 154°43' W.
Debris, POL-contaminated soils

2. Aquatic Environment:

a. Water Resources: Water resources of the planning area consist largely of surface water streams, lakes, and ponds, while ground water is very limited. Climate and permafrost are the dominant factors limiting water availability.

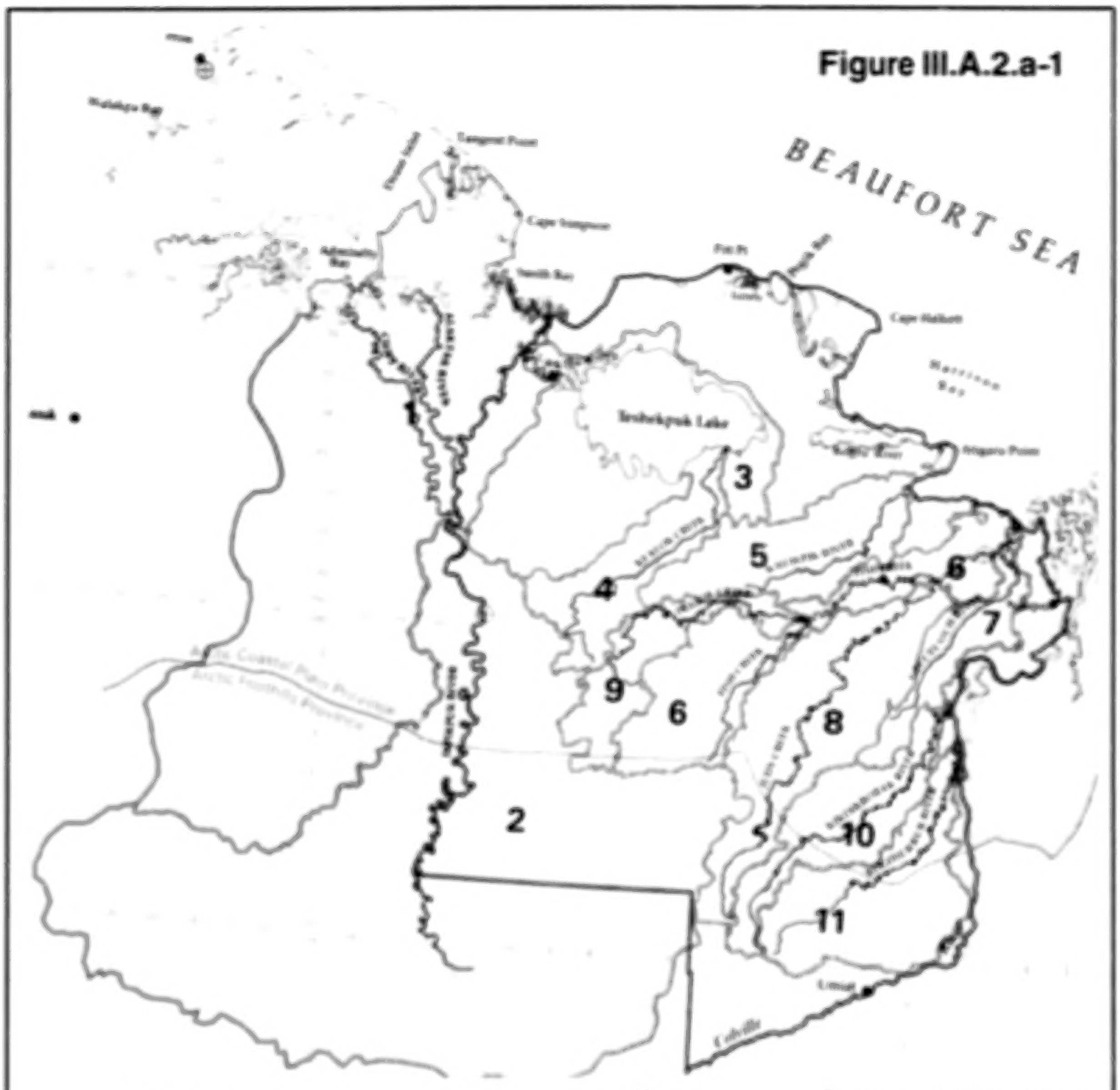
(1) Climatic Factors: Because winters in the planning area are long, most streams and lakes are frozen for much of the year. Summers, while short and relatively cool near the coast, can be somewhat longer and warmer inland. The onset of snowmelt and subsequent runoff often begins earlier in the foothills and moves north as the summer season progresses. Similarly, freezeup usually begins first on the coastal plain and then proceeds southward. Prevailing winds blow cold air off the largely frozen Arctic Ocean, often creating blizzard conditions, drifting and compacting the snow (Sloan, 1987). A little more than half of the total annual precipitation occurs as snow during the winter months [U.S. Department of Agriculture [USDA], 1996). Snowmelt is a dominant factor in arctic hydrology, because it contributes the majority of the annual runoff and helps maintain a saturated layer of surface soils. While rainfall usually is light during the short summers, heavier rainstorms occasionally occur in July and August, especially in the foothills.

(2) Groundwater:

(a) Permafrost: The absence of significant ground- water resources on the North Slope is due largely to the presence of permafrost (Williams, 1970). Permafrost is defined as soil, sand, gravel, or bedrock that has remained below 32° F for 2 or more years (Muller, 1945). Almost continuous throughout the North Slope, permafrost can exist as massive ice wedges and lenses in poorly drained soils or as a relatively dry matrix in well- drained gravel or bedrock. Permafrost forms a confining barrier that prevents infiltration of surface water and restricts groundwater sources to shallow, unfrozen material beneath deep lakes and rivers or deep wells drilled into bedrock beneath the base of the permafrost layer. Melting of ice-rich permafrost causes surface subsidence, often creating thaw lakes, ponds, or beaded stream channels.

(b) Shallow Groundwater Sources: Lakes and rivers deeper than about 6 ft generally do not freeze to

Figure III.A.2.a-1



SUMMARY OF HYDROLOGIC DATA FOR STREAMS

ID	River Name	Mean Elevation (feet)	Size (square miles)	Lake area (square miles)
1	Lower Ikpikpuk River distributary system*	105	3,072	592
2	Ikpikpuk River above confluence of Chipp R	405	4,274	264
3	Miguakiak River	27	1,460	556
4	Kealok Creek	133	349	89
5	Kalikpik River	110	431	107
6	Fish Creek	134	618	116
7	Ublutuoch River	114	216	20
8	Judy Creek	196	699	92
9	Inigok Creek	186	270	57
10	Kikiakrorak River	310	379	17
11	Kogosukruk River	402	543	5

* Includes the Chipp River, Alaktak River, and the Ikpikpuk River below the confluence of the Chipp River

BEST COPY AVAILABLE

125

Table III.A.2.a-1
Summary of Hydrologic Data for Streams in the NE NPR-A Planning Area

Stream Location (lat., long.)	Headwaters	Drainage area (mi^2)	Ave. runoff (cfsm)	Peak runoff (cfsm)	Record Year
Miguakiuk River 70°40'13", 154°19'20"	Coastal Plain	1,460	0.12	1.1	1
Fish Creek 70°19'00", 151°28'36"	Coastal Plain	1,699	0.12*	7.0**	<1
Ikpikpuk River 70°08'12", 154°38'30"	Foothills	3,980	0.29*	58.6**	<1
Colville River (nr. Nuiqsut) 70°09'56", 150°55'00"	Brooks Range	20,670	0.70	29.0	7 ***

Source: Arnborg et al., 1966; Childers et al., 1979; Shannon and Wilson Consultants, 1996; USGS, 1978
*Calculated from regional regression
**Field estimate of maximum evident flood-peak discharge
***Some year's data are incomplete

Table III.A.2.a-2
Summary of Long-Term Stream-Gaging Data for North Slope Streams Outside the Planning Area

Stream Location (lat., long.)	Headwaters	Drainage area (mi^2)	Ave. runoff (cfsm)	Peak runoff (cfsm)	Record Year
Nunavak Creek 71°15'35", 156°46'57"	Coastal Plain	2.8	0.37	47.0	25
Putuligayuk River 70°16'04", 148°37'36"	Coastal Plain	176	0.24	28.3	15
Kuparuk River 70°16'54", 148°57'50"	Foothills	3,130	0.43	37.7	25
Sagavanirktok River 69°05'24", 148°45'34"	Brooks Range	2,208	0.75	28.1	9

Source: USGS, 1979, 1987, 1996

Table III.A.2.a-3
Summary of Hydrographic Data for Selected Lakes in the Planning Area

Lake Location (lat., long.)	Surface Area (mi^2)	Axial Length (mi)	Max. Depth (feet)
Teshekpuk Lake 70°30'00", 153°40'00"	315	20	20
Okalik Lake 70°49'00", 153°23'00"	32	4.2	10
Unnamed Lake 70°34'00", 154°18'00"	26	2.2	20
Unnamed Lake 70°18'00", 153°04'00"	6	2.2	44
Pik Dune Lake 70°13'00", 153°10'00"	9	2.5	22
Unnamed Lake 70°10'00", 153°23'00"	6	2.2	15
Unnamed Lake 70°10'00", 154°13'00"	33	4.5	46
Unnamed Lake 70°03'00", 153°30'00"	21	4.0	45
Unnamed Lake 69°57'00", 154°05'00"	16	3.0	11
Unnamed Lake 69°57'00", 153°15'00"	10	2.5	50

Sources: Bendock, 1979; Bendock and Burr, 1984; Mellor, 1987 the bottom in winter, creating a layer of unfrozen sediments (taliks) beneath (Sloan, 1987). When the sediments consist of porous materials, such as sand or gravel, an aquifer suitable for pumping groundwater may exist. Shallow groundwater wells (galleries) were installed in the bed of the Sagavanirktok River during construction of the Trans-Alaska Pipeline System. While those in the lower river generally provided adequate water supply, others in the upper river did not. Nelson and Munter (1990) describe taliks beneath deep river pools of arctic rivers as a series of discrete units separated by permafrost barriers. The barriers result from the riverbed freezing beneath shallow riffles. This indicates that the supply of groundwater is directly related to the size of the pool in the river (Sloan, 1987). Williams (1970) reported finding water in one of several boreholes in river-valley alluvium about 1 mi northeast of Umiat. Shallow groundwater resources in the planning unit are likely beneath the Colville River, Teshekpuk Lake, and other deep, large lakes.

(c) Deep Sources: Deep wells drilled through the permafrost in the vicinity of Prudhoe Bay have encountered highly mineralized groundwater at depths of 3,000 to >5,000 ft. While geophysical data seem to indicate that the depth to the base of permafrost and the subpermafrost water may be significantly shallower in the planning unit, no well data are available to confirm this (Sloan, 1987).

(d) Springs: Landsat-imagery analysis has located numerous groundwater springs on the North Slope by identifying the large overflow icings (aufeis) created downstream during the winter. However, none of these springs were located in the planning unit (Sloan, 1987).

(3) Surface Water:

(a) Streams: While hydrologic data for the North Slope are sparse (Brabets, 1996), all streams where data are available share somewhat unique stream flow characteristics. Flow generally is nonexistent or at least unmeasurable through most of the winter. Stream flow begins in late May or early June as a rapid flood event termed "breakup" that, combined with ice and snow damming, can inundate extremely large areas in a matter of days. More that half of the annual discharge for a stream can occur during a period of several days to a few weeks (Sloan, 1987). Most streams continue to flow throughout the summer but at relatively low discharges. Runoff is confined to the upper organic layer of soil, as the mineral soils are saturated and frozen at depths >2 to 3 ft (Hinzman, Kane, and Everett, 1993). Rainstorms can produce increases in stream flow but are seldom sufficient to cause flooding. Stream flow ceases at most streams shortly after freezeup in September. Physiography generally is used to divide streams on the North Slope into three types based on their origin—those that originate on the (1) coastal plain, (2) foothills, or (3) in the Brooks Range.

Coastal Plain: The Arctic Coastal Plain can best be characterized as a mosaic of tundra wetlands with extremely low relief. Because the permafrost prevents water from entering the ground and the low relief limits runoff, the coastal plain is covered with lakes, ponds, and generally slow-moving streams. The low gradient limits the development of hydrographic feature, such as gravel bars and steep cut banks. Many of the smaller drainages are choked with aquatic vegetation. Shallow-water tracks resulting from permafrost features often convey significant discharge where surface relief is limited (Hinzman, Kane, and Everett, 1993). Streams that originate in the coastal plain generally have the latest breakup and earliest freezeup. While coastal plain streams have the lowest average runoff, the peak unit runoff is among the highest (Sloan, 1987). The most significant coastal streams in the planning area are the Miguakiak, Kalikpik, and Ublutuoch rivers and the Fish, Kealok, and Inigok creeks.

Foothills: The foothills that comprise the southern portion of the planning area are characterized by a series of low, tundra-covered hills that seldom exceed 1,000 ft in elevation. Streams that originate in these foothills have a moderate gradient and consequently have more gravel-bar and cut-bank features than those of the coastal plain. These streams tend to break up earlier, freeze up later, and have a slightly higher average unit runoff than streams of the coastal plain. The Ikpikpuk River forms the western boundary of the planning area. Other significant streams that originate in the foothills of the planning area include Judy Creek and the Kikiakrorak and Kogosukruk rivers.

Brooks Range: The Colville River forms most of the southern and eastern boundaries of the planning area. It is the largest river on the North Slope and intercepts all of the streams originating in the Brooks Range that flow north towards the planning area. As the only river that includes mountainous and glacial drainage, the Colville carries the highest sediment load and exhibits the greatest range of geomorphic features. Steep cut-bank cliffs, deep pools, and large gravel bars are common to most of the river adjoining the area. Breakup and freezeup are more complex along the Colville River due to the extreme length and range of elevation. Flow generally persists later in the winter than in any other river on the North Slope. It also is the only river in the planning area with more than 1 year of daily stream flow and annual flood-peak discharge records (Shannon and Wilson, 1996).

The location of streams in the planning area is shown in Figure III.A.2.a-1. Hydrologic data for streams in the planning area are summarized in Table III.A.2.a-1. For

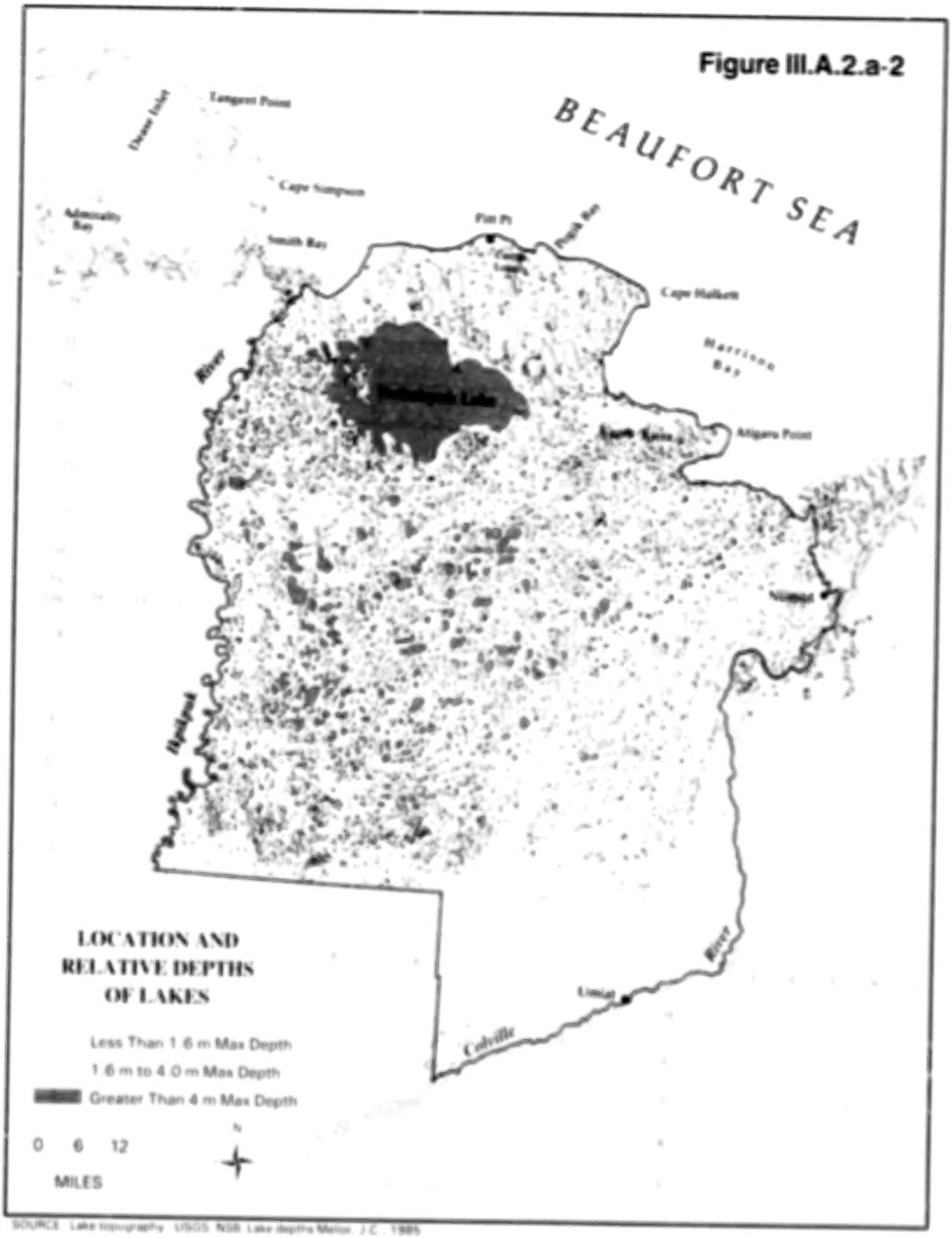


Figure III.A.2.a-2

LOCATION AND RELATIVE DEPTHS OF LAKES

SOURCE Lake topography USGS NSB Lake depths Mellor, J.C., 1985

BEST COPY AVAILABLE

128

comparative purposes, data for streams outside the planning area with long-term stream flow records are listed in Table III.A.2.a-2.

(b) Lakes: Lakes and ponds are the most common feature of the northern portion of the planning area. Unlike streams, which only hold large quantities of water during breakup, lakes store water year-round and probably are the most readily available water source on the North Slope (Sloan, 1987). Sellman et al., (1975) state that the origin of most lakes and ponds on the coastal plain is due to thawing of ice-rich sediments. Orientation and lake morphology are a result of wave action from prevailing winds and local topography. Because waterbodies less than about 6 ft deep freeze to the bottom most winters, lake depth is a major factor in determining year-round water sources. Lakes generally are classified by depth as either shallow or deep lakes.

Shallow Lakes and Ponds: The coastal plain of the planning unit is dominated by shallow lakes and ponds, those less than about 6 ft deep. These are thought to originate from thawing of the shallowest, ice-rich permafrost layer. The top 10 to 12 ft of permafrost may contain up to 80 percent segregated ice near the coast (Sellmann et al., 1975). Any disturbance of the vegetation or water or wind erosion could initiate melting of this subsurface ice thermokarst.

The lakes and ponds often are elongated with a strong north-south orientation. This probably is a result of preferential erosion due to wind-generated longshore currents (Sellman, et al., 1975). The shallow lakes and ponds freeze up in September and become ice-free in late June or early July, about a month earlier than the deep lakes. While ponds and shallow lakes generally lack fish, they may provide significant habitat to invertebrates and migratory animals (due to the earlier availability of ice-free areas).

Deep Lakes: Teshekpuk Lake and the southern and western areas of the coastal plain within the planning unit contain numerous deep-lake basins Mellor (1987). Bendock (1984) surveyed over 60 of these lakes in the planning area and found more than 40 exceeded 10 ft in depth. Teshekpuk Lake, the largest lake on the North Slope with an area of 315 mi², provides a great diversity of habitat types. Besides a depth in the central basin of >20 ft, the complex shoreline features bays, spits, lagoons, islands, and beaches as well as extensive shoal areas. The complex shoreline and bathymetric features of the lake's current configuration probably are the result of the coalescence of numerous smaller but still sizeable lakes (Weller and Derksen, 1979). The hydrodynamics of the deep lakes often are complex. While the Miguakiak River usually is the outlet of Teshekpuk Lake, stream flow reverses when the Ikpikpuk River is flooding (Sloan, 1987). Teshekpuk Lake and other deep lakes provide an overwintering area for fish and aquatic invertebrates and the most readily available winter water supply.

The location and relative depth of lakes in the planning area are shown in Figure III.A.2.a-2. Hydrographic data for some representative lakes in the planning area are summarized in Table III.A.2.a-3.

b. Water Quality: Most freshwaters in the planning area are pristine; most, like those of Teshekpuk Lake, are soft, dilute calcium-bicarbonate waters. Near the coast, sodium chloride (salt) concentrations predominate over bicarbonate concentrations (Prentki et al., 1980; USDOI, BLM NPR-A Task Force, 1978).

The freeze thaw cycle in the Arctic plays a controlling role in water quality. In winter, surface waters <6 ft deep freeze solid (Hobbie, 1984). In such waters, major ions and other "impurities" are excluded from downward-freezing ice in fall and forced into the underlying sediment. Most of the ions remain trapped in the sediment after the next spring's meltout, giving these waters a very low dissolved-matter concentration. During the summer, dissolved-matter concentrations slowly increase as ice in the bottom sediment melts and the sediments compress (Miller, Prentki, and Barsdate, 1980).

In waters >6 ft, ions are forced into the deeper water column with a proportionate increase in concentrations of dissolved materials. As a result, distinct off-flavor and saline taste affect the potability of water from shallower "deep-water" lakes and river pools by late winter. Despite the high dissolved-material concentrations and marginal potability, these deep waters are the basis for fish-overwintering habitat and the primary sources of winter water supply.

During snowmelt, the lakes form moats—a ring of water at the shoreline. For deeper lakes, the winter ice cover persists through spring snowmelt and protects the winter-formed pycnocline (the plane separating two layers of different density). Snowmelt waters flow just below the ice (O'Brien et al., 1995) or along the moated margins of the lakes, but above the pycnocline. These snowmelt waters pass through and exit over flooded tundra in sheet flow or through shallow outlets without contributing to lake chemistry. Only after peak snowmelt and waterflow does the protective ice cover of deeper lakes melt and allow the wind to mix the water column, destroying the pycnocline. The net result of this flow regime in deeper lakes is to preserve their existing water chemistry from that of snowmelt waters.

(1) Potability: Ponds and local streams are highly colored from dissolved organic matter and iron; the water tastes fine but is considered marginally potable to unpotable because of iron staining and fecal contamination in areas with dense avian (Ewing, 1997), caribou, and lemming populations. Lemming fecal material is generally abundant in upper coastal tundra soils (Gersper et al., 1980). During lemming highs, winter accumulation of lemming fecal material is sufficient to affect both minor and major ion chemistry of early snowmelt waters (Chapin, Barsdate, and Barel, 1978; Barsdate and Prentki, 1973). Cold temperatures, a characteristic of tundra soils and waters, tend to prolong the viability of fecal coliform (FC), the standard water-quality measure for fecal contamination. Thus, some smaller waterbodies in the NPR-A may exceed State of Alaska standards for FC in drinking water or water recreation due to local wildlife abundance. (There is no State standard applicable to growth and propagation of natural aquatic life or wildlife.) Lakes and larger rivers tend to be less colored and would be less likely to be contaminated with FC. Teshekpuk Lake, Miguakiak River, and the Ikpikpuk River within the Cabins/Camp Land Use Emphasis Area, however, may be at risk from FC contamination because of the increase in unregulated long-term campsites and cabins, all without adequate sewage disposal.

(2) Turbidity: Most NPR-A freshwaters have low turbidity or suspended-solid concentrations. The exceptions are the larger rivers, possibly shallow floodplain lakes, and waters from thermokarst erosional features. Thermokarst is an altering of the terrain caused by melting permafrost that results in subsidence and water poolings.

Approximately 70 percent of the sediment load for the Colville River is carried during breakup, with suspended-sediment concentrations reaching 870 parts per million (ppm) (USDOI, BLM NPR-A Task Force, 1978). Later in summer, suspended-sediment concentrations decrease to as low as 3 ppm. The Colville River, with its origins in the foothills of the Brooks Range, carries a greater suspended load than rivers originating within the coastal plain, and it is the most turbid river in the coastal plain of the NPR-A. Other NPR-A rivers range from about 100-ppm suspended sediment at peak-flow rates down to 3 to 10 ppm at lower rates. In the Imnavait Creek watershed in the foothills along the Haul Road, late-summer suspended-sediment concentrations were on the order of 4 to 6 ppm in sheet, water-track, and stream flow (Everett, Kane, and Hinzman, 1996).

In arctic-river floodplains, the more turbid snowmelt runoff is funneled through the moats and surface layer above the pycnocline of deeper lakes, greatly limiting their postrunoff turbidity. However, shallower lakes lose ice cover during runoff. Without the moat system to deflect turbid waters, these shallower, floodplain lakes can become and remain turbid throughout the summer.

(3) Alkalinity and pH: Alkalinity and pH are important parameters in controlling the susceptibility of freshwaters to acid rain or acid snowmelt. Alkalinity is a measure of the acid-buffering capacity of the water. The pH is a measure of how acid the water is. A pH of 7 indicates a neutral balance of acid and base; a pH below 7 indicates acid water. The State considers a pH range within 6.5 to 9.0 necessary to protect aquatic wildlife.

In NPR-A coastal tundra, freshwaters are only weakly buffered (Prentki et al., 1980; O'Brien et al., 1995; USDOI, BLM, NPR-A Task Force, 1978; Hershey et al., 1995). In ponds, alkalinities during snowmelt are about twofold lower than the midsummer alkalinities of 0.4 milliequivalent per liter (meq/l). Lake alkalinities also are low, on the order of 0.5 meq/l. Alkalinities in individual NPR-A coastal rivers are higher, ranging from about 0.3-0.4 to 1.3-1.6 meq/l in summer, with higher values at lower flow rates. The Kuparuk River and tundra foothill streams east of the NPR-A have lower alkalinities, 0.05 to 1.1 meq/l. In NPR-A rivers, winter alkalinities in unfrozen pools are on the order of 3 to 4 meq/l.

In ponds, pH's are depressed to under pH 7 as snowmelt runoff enters them, and their pH's then rapidly increase to between pH 7 and 7.5 after snowmelt (Prentki et al., 1980). The initial low pH is due to acidity of snow on the North Slope, with a median pH of 4.9 (Sloan, 1987). This low pH, less than the pH 5.5 expected for uncontaminated precipitation, is thought to be a result of sulfate fallout from industrially contaminated arctic air masses. In lakes, pH's are near neutral, about pH 7 (O'Brien et al., 1995). In tundra brown-water streams and some foothill streams, pH's can be <6 (Milner, Irons, and Oswood, 1995; Hershey et al., 1995; Everett, Kane, and Hinzman, 1996). The acidity in at least the brown-water streams is attributable to naturally occurring organic acids. In tundra rivers, pH's are higher, seasonally ranging between 6.4 and 8.2 in the Colville, Meade, Chipp, and Miguakiak rivers (USDOI, BLM, NPR-A Task Force, 1978).

(4) Oxygen: Most of the world's surface waters are near saturation with dissolved oxygen. Due to this tendency toward saturation, the absolute concentration of dissolved oxygen in arctic waters tends to be higher than in other waters, because the solubility of oxygen increases with decreasing water temperature. This generality applies to clear-water streams and clear-water (i.e., larger) lakes in the planning area. Summer concentrations of dissolved oxygen in NPR-A rivers range from 9 to 12 ppm by weight (USDOI, BLM, NPR-A Task Force, 1978).

However, colored-water streams, ponds, and lakes in the Arctic and elsewhere generally are undersaturated with respect to oxygen. Oxygen-saturation values in open ponds in the NPR-A generally fall below 100 percent, although a range between 60 and 118 percent has been observed (Prentki et al., 1980). Oxygen values can be much lower (<10% saturation) in vegetated shorelines or in water pooled on wet tundra. In these locations, respiration in the underlying sediment is depleting oxygen from the water as rapidly as the water can take up oxygen from the air.

In winter, in deeper NPR-A coastal plain lakes, waters remaining beneath the ice tend to become supersaturated with oxygen (Prentki et al., 1980; USDOI, BLM, NPR-A Task Force, 1978; O'Brien et al., 1995). During ice formation, dissolved oxygen is excluded from the ice into the water column. Exclusion adds more oxygen than underwater respiration removes. In Ikroavik Lake near Barrow, for example, saturation was 120 to 140 percent in December; by early June when 5.2 ft of ice had formed in the 7.9-ft-thick water column, saturation had reached 174 percent. During late winter in Teshekpuk Lake in 12 ft of water underneath 7.9 ft of ice, oxygen has been measured at 19.0 ppm, equivalent to about 140 to 150 percent saturation. The winter oxygen regime can be different in foothills lakes, where a more complex bathymetry can inhibit mixing. For example, in Toolik Lake, in the foothills to the east of the NPR-A, late-spring dissolved-oxygen concentration decreased to 1.4 ppm in an isolated 82-ft-deep basin. However, detailed sediment chemistry has established that Toolik Lake bottomwaters do not go anoxic.

Late-winter measurements of oxygen in unfrozen pools in smaller NPR-A rivers (Avalik, Meade, and Chipp rivers; USDOI, BLM, NPR-A Task Force, 1978) indicate significant residual oxygen (>9 ppm) and 70 to 99 percent saturation. The Colville River, with deep, connected channels in its delta, also maintains adequate to supersaturated winter oxygen concentrations (Reynolds, 1995; USDOI, BLM NPR-A Task Force, 1978).

(5) Sources of Oil and Hydrocarbons in the NPR-A: The NPR-A, including the planning area, has several known oil seeps (McCown, Brown, and Barsdate, 1973; Barsdate, Alexander, and Benoit, 1973; Magoon and Claypool, 1988; Becker and Manen, 1989; Steinhauer and Boehm, 1992). These include multiple seeps on Cape Simpson, just to the west of the planning area, and the Oil Lake and Fish Creek seeps in the northeast corner of the planning area. The peat that underlies the North Slope carries a significant hydrocarbon content. This content is evidenced by natural sheens that occur in ponds or flooded footprints in the tundra, in the foam on the downwind shoreline of lakes on windy days, and by elevated hydrocarbon levels in sediments with peat. The Colville River drainage includes coal and oil-shale outcrops, the oil seeps, and peat.

(6) Indicator Hydrocarbons: Hydrocarbons derived from the various sources are detectable as elevated levels of saturated and polycyclic aromatic hydrocarbons (PAH) in Colville River sediment and, downriver, in Harrison Bay sediment (Boehm et al., 1987). Additional pyrogenic PAH signals also are significant in tundra soils and form a depositional record of atmospheric fallout from tundra fires. Concentrations of indicator hydrocarbons from these multiple sources are both high and chemically similar to those found in petroleum and make it difficult to detect or distinguish any nonpoint-source anthropogenic contamination from natural background. Similarly high levels of hydrocarbons have been found in other major Beaufort Sea rivers and also have been attributed to natural sources (Boehm et al., 1987; Yunker and MacDonald, 1995).

(7) Federal Contaminated Sites: There are multiple Department of Defense hazardous-waste sites and Federal drill sites within the NPR-A (Sec. III.A, Hazardous Material), which may be point sources for contamination. There have been at least 126 wells drilled by the Federal Government within the NPR-A (Bird, 1988). When these wells were drilled, it was common practice to discharge and leave drilling fluids in open reserve pits. Elevated levels of trace metals in water (zinc and chromium) and sediments (copper, chromium, and lead) have been found in ponds at least as far as 700 ft from reserve pits elsewhere on the North Slope (Woodward et al., 1988). Elevated levels of petroleum hydrocarbons also were found in water and sediment in the same study. Waters from the reserve pits and some ponds within 160 ft but not at greater distances were found to be toxic to a sensitive zooplankton species in bioassays.

3. Atmospheric Environment:

a. Climate and Meteorology: The climate of the planning area can be divided into the Arctic Coastal, Arctic Inland, and Arctic Foothills zones (Zhang, Osterkamp, and Stamnes, 1996). The Arctic Coastal *Zone* is characterized by cool summers and relatively warm winters due to its proximity to the ocean. Precipitation is lowest in this region and >50 percent falls as snow. The Arctic Inland *Zone* has the warmest summers and coldest winters in the region. Precipitation is higher than in the Arctic Coastal *Zone*, and approximately 40 to 45 percent occurs as snow (Zhang, Osterkamp, and Stamnes, 1996). The Arctic Foothills *Zone* has the warmest winters. Summer temperatures are cooler than those of the Arctic Inland *Zone*. Precipitation is the highest of the three zones, and 40 percent occurs as snow (Zhang, Osterkamp, and

Table III.A.3.a-1
Climatic Conditions in Alaska North of the Brooks Range

	Arctic Foothills	Arctic Inland	Arctic Coast
Distance to the ocean (km)	150 to 300	200 to 150	<20
Elevation (m)	300 to 1,000	50 to 400	<50
Air Temperature (°C)			
Mean diurnal amplitude	10 to 15	8 to 14	4 to 8
Range (extreme low-high)	−50 to +30	−65 to + 35	−50 to + 26
Mean annual	−8.6	−12.4 ± 0.4	−12.4 ± 0.4
Annual amplitude	16.8	21.1 ± 0.5	17.5 ± 1.2
Degree-Day (°C-day)			
Freeze	4000	5300 ± 70	4930 ± 150
Thaw	800	930 ± 160	420 ± 120
Precipitation (mm)[*]			
Snow	156	126	113
Rain	168	103	85
Annual total	324	229	198
Seasonal Snow Cover			
Average starting date	27 Sep	1 Oct	27 Sep
Range	11 Sep. to 15 Oct	19 Sep. to 12 Oct	4 Sep. to 14 Oct
Average duration (days)	243	236	259
Range (extreme)	226 to 261	198 to 260	212 to 288
Average maximum thickness (cm)	—	43	32
Range (extreme)	—	28 to 70	10 to 83
Thaw Season			
Average starting time	28 May	25 May	6 Jun
Range (extreme)	18 May to 15 Jun	28 Apr to 6 Jun	26 May to 19 Jun
Average length (days)	122	129	106
Range (extreme)	104 to 139	105 to 167	77 to 153

Source: Zang, Osterkamp and Stamnus, 1996

[*] From Natural Resources Conservation Service, 1994

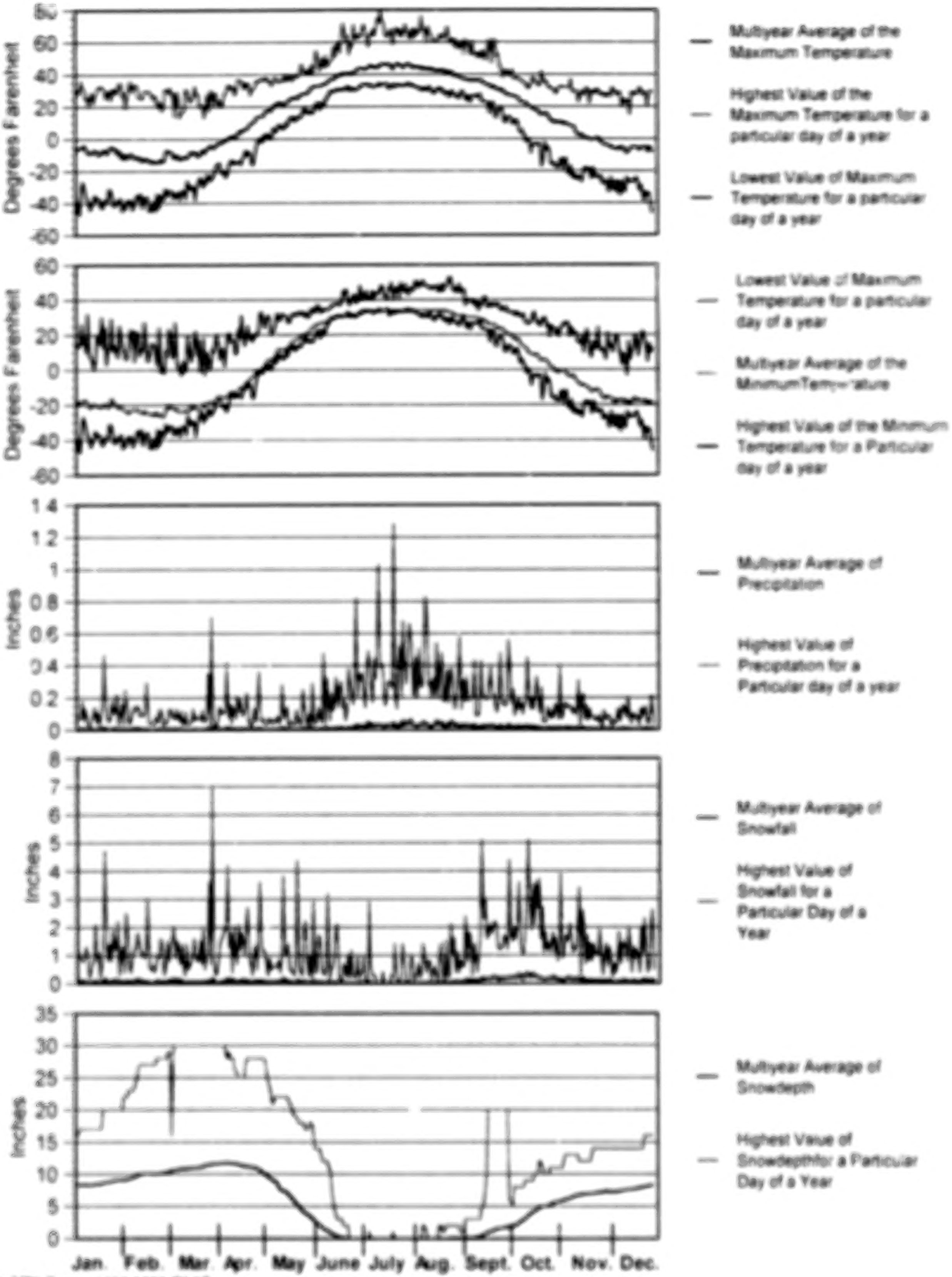
Stamnes, 1996). The climatic conditions for the three zones are summarized in Table III.A.3.a-1.

Figures III.A.3.a-1 and III.A.3.a-2 show the seasonal variation of the mean monthly air-temperature maximums and minimums, precipitation, snowfall, and snow depth averaged over the period of record from 1949 to 1996 for Barrow and Umiat, Alaska. Air temperatures generally remain below freezing for 9 months of the year. Average monthly temperatures range from -20 to +40 °F at Barrow on the coast to -25 to +53 °F at Umiat in the foothills (Leslie, 1986).

Of all the factors contributing to variations in surface conditions, snow cover experiences the largest fluctuations spatially and temporally. Not only does the snow cover have a large seasonal cycle, but it exhibits a substantial interannual variability. The timing of the establishment of seasonal snow cover on the North Slope varies from late September to early October, while the date on which seasonal snow cover disappears ranges from late May through the middle of June (Zhang, 1993; Zhang, Stamnes, and Bowling, 1996). Interannual variations in the timing of snowmelt are mainly due to changes in the incoming longwave radiation (Zhang, Bowling, and Stamnes, 1997). The average snow depth from January through April is 10 and 15 in respectively for Barrow and Umiat.

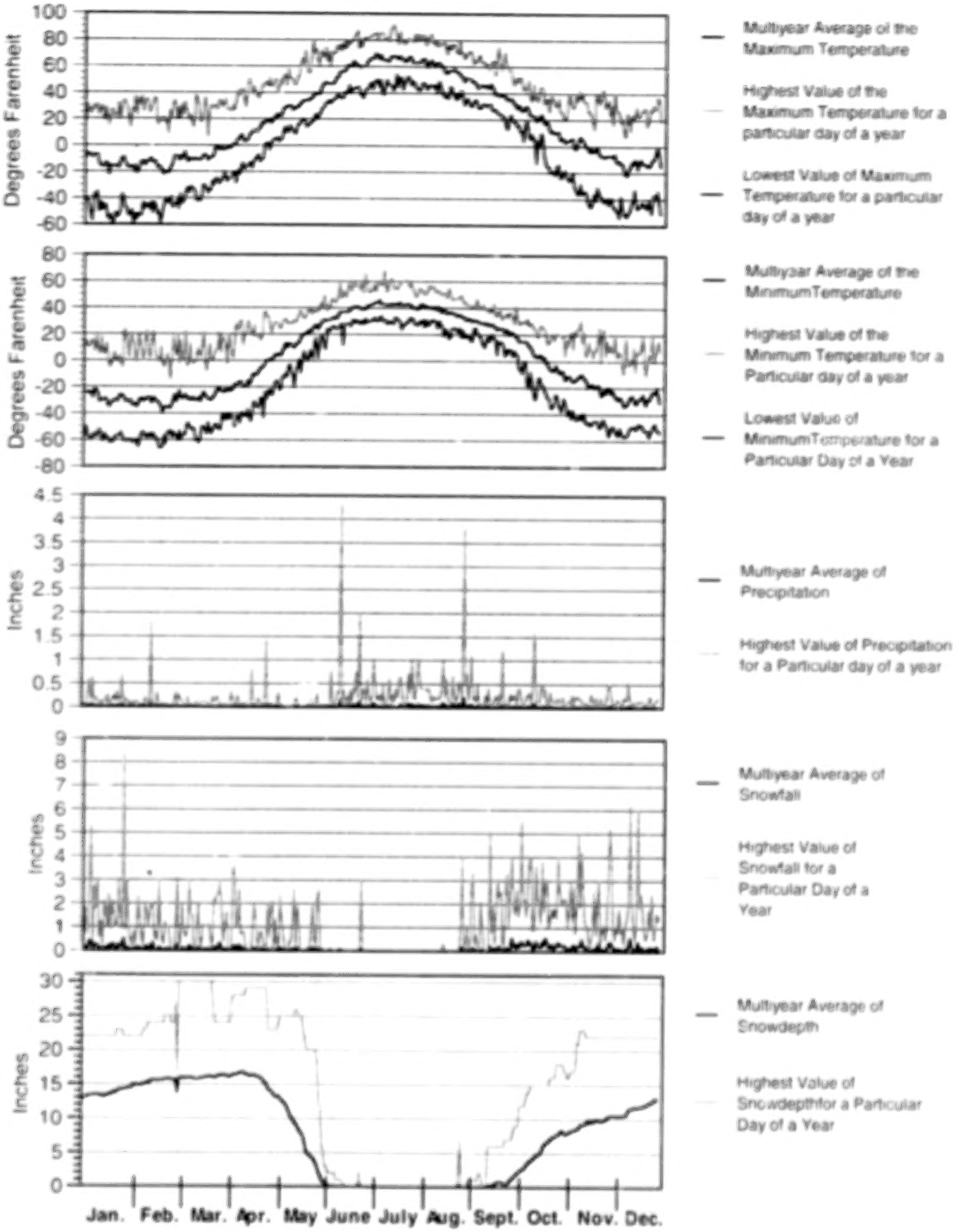
The USGS collected snow-survey data in the NPR-A from 1977 to 1979 and 1982 to 1983. Snow depths ranged from 0.85 to 1.4 ft and water-equivalent from 3.5 to 5.1 in (Sloan, 1987). This compares to the long-term (1961–1990) averages of winter precipitation of 3.6 and 4.5 in, collected from Wyoming windshield total precipitation gauges at Barrow and Sagwon, respectively (USDA, 1996). Rainfall usually is light during the short summers, but heavier rainstorms occasionally occur, most commonly in the foothills. Summer precipitation, generally greatest in July and August, ranges from 3.6 to 4.5 in, collected from these same gauges at Barrow and Sagwon, respectively (USDA, 1996). However, different types of precipitation gauges can exhibit large variations in catch efficiency in windy environments, so that the actual water-equivalent in the snowpack can vary significantly with that reported by weather stations (Kane et al., 1992).

Prevailing winds are from the east-northeast, blowing cold air off the largely frozen Arctic Ocean. The windiest months are in winter, often creating blizzard conditions, eroding the snow from ridges, and drifting the snow into protected side slopes and valley bottoms (Sloan, 1987). Occasional southerly winds break this pattern and somewhat moderate temperatures, but these winds seldom reach much beyond the foothills (Benson, 1987). Besides redistributing snowfall, the strong winds can alter the snowpack by redeposition and densification as well as



Source: Http://www.wrcc.sage.dri.edu

Figure III.A.3.a-1 Meteorological Parameters Maximum Temperature, Minimum Temperature, Precipitation, Snowfall and Snowdepth for BARROW WSO ALASKA for the period of record September 2, 1949 through June 30 1996.



Source: Http://www.wrcc.sage.dri.edu

Figure III.A.3.a-2. Meteorological Parameters Maximum Temperature, Minimum Temperature, Precipitation, Snowfall and Snowdepth for UMIAT WSO ALASKA for the period of record September 2, 1949 through June 30, 1996

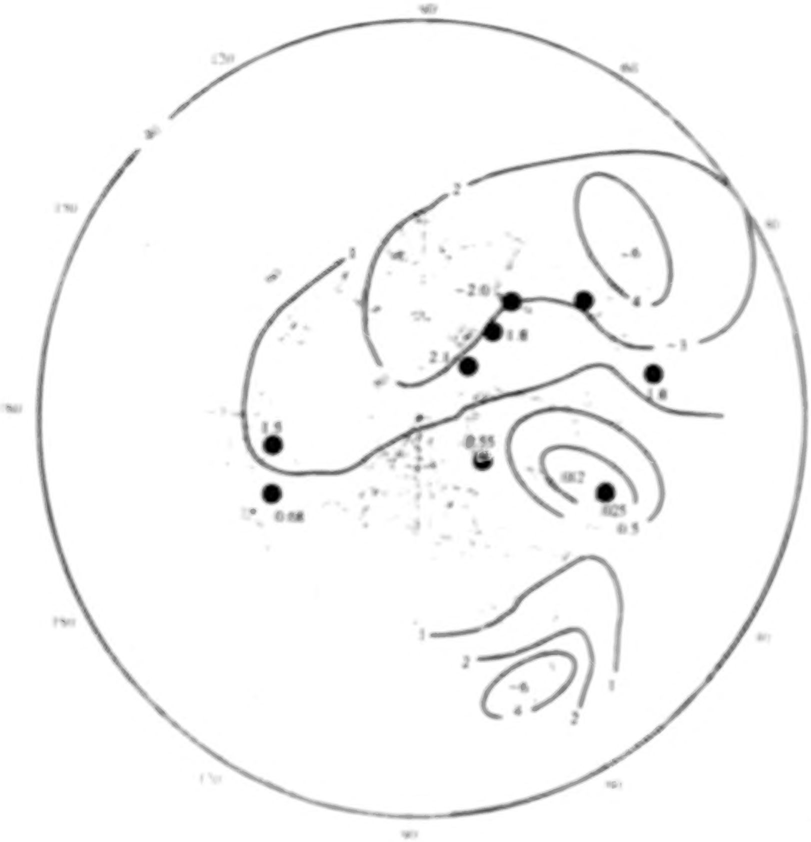


Figure III.A.3.b-1. Mean Winter Concentrations of Pollutant Sulphate (µg/m³) in Surface Aerosol of Arctic and Environs. Source: After Rahn, 1982.

significantly reducing the snowpack through sublimation (Kane et al., 1992). In the summer, strong winds may increase evaporation and generate water currents in ponds and lakes.

b. Air Quality: The existing onshore air quality for the NPR-A area is considered to be relatively pristine, with concentrations of regulated air pollutants that are far less than the maxima allowed by the National Ambient Air Quality Standards (national standards) and State air-quality statutes and regulations (USEPA, 1978). These standards are designed to protect human health. Areas where national standards are attained are referred to as attainment areas; others are nonattainment areas. The entire North Slope of Alaska is an attainment area. Under provisions of the Prevention of Significant Deterioration (PSD) Program of the Clean Air Act, existing air quality superior to the national standards is protected by additional limitations on nitrogen dioxide, sulfur dioxide, and total suspended-particulate matter. Areas in Alaska currently are designated as PSD Class I or II. The Class I designation is the most restrictive and applies to certain national parks, monuments, and wilderness areas. There are no Class I areas in or near the NPR-A. The entire NPR-A area is designated Class II. The applicable standards and PSD Class II increments are listed in Table III.A.3.b-1.

Over most of the NPR-A area, there are only a few small, scattered emissions from widely scattered sources principally from diesel-electric generators in small villages. The only major local sources of industrial emissions near the planning area are in the Prudhoe Bay/Kuparuk/Endicott oil-production complex. This area was the subject of two monitoring programs from 1986 to 1987 (ERT, 1987; Environmental Science and Engineering, Inc., 1987). In each case, two monitoring sites were selected, one deemed subject to maximum air-pollutant concentrations and the other more representative of the air quality of the general Prudhoe Bay area. The 1-hour maximum-value standard for ozone at site C (Table III.A.3.b-2) apparently was exceeded; however, it was determined that the high ozone level may have been caused by arc welding within 150 m of the monitoring site. However, the results demonstrate that, generally, most ambient-pollutant concentrations, even for sites deemed subject to maximum concentrations, meet the ambient-air-pollution standards. This is true even if the baseline PSD concentrations (which must be determined on a site-specific basis) are assumed to be zero, limiting the allowable increase in concentrations.

During winter and spring, pollutants are transported to arctic Alaska across the Arctic Ocean, from industrial Europe and Asia (Rahn, 1982). These pollutants cause a phenomenon known as arctic haze. Pollutant sulfate due to arctic haze in the air in Barrow—that in excess of natural background—then averages 1.5 micrograms per cubic meter. The concentration of vanadium, a combustion product of fossil fuels, then averages up to 20 times the

Table III.A.3.b-1
Relevant Ambient-Air-Quality Standards (Measured in $\mu g/m^3$; an asterisk [*] indicates that no standards have been established.)

	Averaging Time Criteria					
Pollutant[1]	Annual	24 hr	8 hr	3 hr	1 hr	30 min
Total Suspended Particulates[2]	60[3]	150	*	*	*	*
Class II[4]	19[3]	37	*	*	*	*
Carbon Monoxide	*	*	10,000	*	40,000	*
Ozone[5]	*	*	*	*	235[6]	*
Nitrogen Dioxide	100[7]	*	*	*	*	*
Class II[4]	25[7]	*	*	*	*	*
Inhalable Particulate Matter (PM10)[8]	50[9]	150[10]	*	*	*	*
Class II[4]	17	30	*	*	*	*
Lead	1.5[11]	*	*	*	*	*
Sulfur Dioxide	80[7]	365	*	1,300	*	*
Class II[4]	20[7]	91	*	512	*	*
Reduced Sulfur Compounds[2]	*	*	*	*	*	50

Source: State of Alaska, DEC, 1982, 80, 18, AAC, 50.010, 18 AAC 50.020, 40 CFR 52.21 (43 FR 26388), 40 CFR 50.6 (52 FR 24663), 40 CFR 51.166 (53 FR 40671). [1] All-year averaging times not to be exceeded more than once each year, except that annual means may not be exceeded. [2] State of Alaska air-quality standard (not national standard). [3] Annual geometric mean. [4] Class II standards refer to the PSD Program. The standards are the maximum increments in pollutants allowable above previously established baseline concentrations. [5] The State ozone standard compares with national standards for photochemical oxidants, which are measured as ozone. [6] The 1-hour standard for ozone is based on a statistical, rather than a deterministic, allowance for an "expected exceedance during a year." [7] Annual arithmetic mean. [8] PM10 is the particulate matter less than 10 micrometers in aerodynamic diameter. [9] Attained when the expected annual arithmetic mean concentration, as determined in accordance with 40 CFR 50 subpart K, is equal to or less than 50 $\mu g/m^3$. [10] Attained when the expected number of days per calendar year with a 24-hour average concentration above 150 $\mu g/m^3$, as determined in accordance with 40 CFR 50, subpart K, is equal to or less than 1. [11] Maximum arithmetic mean averaged over a calendar quarter.

Table III.A.3.b-2
Measured Air-Pollutant Concentrations at Prudhoe Bay, Alaska, 1986-1987
(Measured in $\mu g/m^3$; absence of data is indicated by asterisks [**].)

	Monitor Sites					
Pollutant[1]	A[2]	B[3]	C[4]	D[5]	National Standards[6]	Class II Increments[7]
Total Suspended Particulates						
Annual	8.4	**	14.8	**	60	19
Annual Max. 24 hr	79.7	**	104[8]	**	150	37
Ozone						
Annual Max. 1 hr	92.1	170.5	265[9]	67	235	
Nitrogen Dioxide						
Annual	15.8	7.5	16	4	100	25
Inhalable Particulate Matter (PM10)						
Annual	**	**	10.5	**	50	17
Annual Max. 24 hr	**	**	25[8]	**	150	30
Sulfur Dioxide						
Annual	7.9	**	3	**	80	20
Annual Max. 24 hr	15.7	**	80.5[8]	**	365	91
Annual Max. 3 hr	21.0	**	**	**	1,300	512
Carbon Monoxide						
Annual Max. 8 hr	**	**	1,400	**	10,000	
Annual Max. 1 hr	**	**	2,500[8]	**	40,000	

Sources: ERT, 1987, and Environmental Science and Engineering, 1987. [1] Lead was not monitored. [2] Site CCP (Central Compressor Plant), Prudhoe Bay monitoring program, selected for maximum pollutant concentrations. [3] Site Pad A (Drill Pad A), Prudhoe Bay monitoring program, site of previous monitoring, selected to be more representative of the general area or neighborhood. [4] Site CPF-1 (Central Processing Facility), Kuparuk monitoring program, selected for maximum pollutant concentrations. [5] Site DS-1F, Kuparuk monitoring program site selected to be representative of the general area or neighborhood. [6] Applicable National Ambient-Air-Quality Standards. Please refer to Table III.A.3.b-1 for more specific definitions of air-quality standards. [7] Class II PSD Standard Increments. [8] Second highest observed value (in accordance with approved procedures for determining ambient-air quality). [9] The highest value for ozone at site C (CPF-1) may have been atypical due to field operations using arc welding within 150 m of the site; otherwise, the highest value at the site was 174.7 $\mu g/m^3$.

background levels in the air and snowpack. Recent observations of the chemistry of the snowpack in the Canadian Arctic also provide evidence of long-range transport of small concentrations of organochlorine pesticides (Gregor and Gummer, 1989). Concentrations of arctic haze during winter and spring at Barrow are similar to those over large portions of the continental U.S. (Fig. III.A.3.b-1), but they are considerably higher than levels south of the Brooks Range. Any ground-level effects of arctic haze on the concentrations of regulated air pollutants in the Prudhoe Bay area are included in the monitoring data given in Table III.A.3.b-2. Despite this seasonal, long-distance transport of pollutants into the Arctic, regional air quality still is better than that specified by existing standards.

BLANK PAGE

B. BIOLOGICAL RESOURCES:

1. Special Areas and Special Management Zones: The Naval Petroleum Reserves Production Act of 1976 authorized the Secretary of the Interior to designate, within the NPR-A, areas "containing any significant subsistence, recreational, fish and wildlife, historical or scenic value." These areas were to be managed during exploration to "assure the maximum protection of such surface values to the extent consistent with the requirements of this Act for exploration of the reserve." Federal regulations, under 43 CFR 2361.1(e)(1), state that such values may be protected by limiting, restricting, or prohibiting the use of and access to appropriate lands.

The Act mentioned the Utukok River and Teshekpuk Lake areas. In a 1977 *Federal Register* (*FR*) notice, the Secretary of the Interior described these two areas and designated a third. The Utukok River Uplands Special Area (URUSA) contains critical calving habitat for caribou and covers about 4 million acres. The Teshekpuk Lake Special Area (TLSA), approximately 1.7 million acres in size, includes important nesting, staging, and molting habitat for a large number of ducks, geese, and swans. The Colville River Special Area (CRSA) contains river bluffs that are critical nesting habitat for the arctic peregrine falcon; the CRSA is about 2.3 million acres in size. No additional special areas have been designated by the Secretary of the Interior since 1977, but the authority to do so remains.

The URUSA is not within the current planning area; it is about 65 mi from it. Approximately the northeastern third of the CRSA is within the planning area; the remainder is farther upstream on the Colville River. Almost the entire TLSA is within the planning area boundary. Only a small portion along the western side of the TLSA lies west of the Ikpikpuk River. (See Fig. III.B.1-1 showing the 3 special areas and the planning area.)

The Record of Decision (ROD) on Oil and Gas Leasing and Development in the National Petroleum Reserve in Alaska (May 1983) described the preferred alternative that included a depiction of four Special Management Zones (SMZ). Three of these were similar to the existing three special areas. The zone in the vicinity of the Utukok River included values for grizzly bear habitat as well as caribou, and the zone around Teshekpuk Lake included values for caribou as well as waterfowl. Each of these two zones surrounded an area that would be deleted from oil and gas leasing rather than be managed as part of the SMZ. A fourth SMZ was separated into five segments in coastal areas and established for waterbirds. The ROD would require the lessee to do research to show that any proposed exploration or development activity within the SMZ would have little or no permanent adverse effects on the values within.

The Teshekpuk Lake SMZ is entirely within the boundary of the current planning area, as is the northeastern third of the Colville River SMZ. Two of the five segments of the waterbird SMZ also are within the planning area, but the larger of the two is included in lands that have since been conveyed to the local Native Corporation. (See Fig. III.B.1-2 showing the planning area and 3 SMZ's.)

The special areas were authorized by law and codified by the Secretary of the Interior. Those designations will remain in effect until the law is amended or repealed, or until the Secretary changes the regulations that codify them. The SMZ's are products of a final EIS and ROD and, as such, can be directly changed in any way by the ROD that results from this current EIS. None of the alternatives under consideration in this IAP/EIS would retain the SMZ's. However, this IAP/EIS introduces the concept of LUEA's (Sec. II), which are meant to accomplish similar purposes.

2. Vegetation: Efforts to map the vegetation of Alaska's North Slope occurred as early as 1944 (Spetzman, 1959). Early efforts used aerial photography and ground reconnaissance, while more recent studies used digital satellite data. For a bibliography of the earlier efforts and a more complete coverage of recent studies, see Talbot (1996). The studies using satellite data concentrated on three areas of the North Slope. At the eastern end, three vegetation-mapping studies were completed for part or all of the Arctic National Wildlife Refuge (ANWR) (Walker et al., 1982; Markon, 1986; Jorgenson et al., 1994). The two earlier studies used Landsat Multispectral Scanner (MSS) data, while the more recent study used the next-generation Landsat Thematic Mapper (TM). The greatest intensity of vegetation studies occurred on the central North Slope in the vicinity of the Prudhoe Bay oilfields. Here Walker and associates (e.g., Walker and Acevedo, 1987) have produced a number of vegetation maps and reports that not only describe the vegetation of the area, but provide techniques to show the changes over time as a result of oilfield development. West of Prudhoe Bay, a vegetation map for all of the NPR-A was produced by Morrissey and Ennis (1981) using Landsat MSS data. A portion of the current planning area north and east of Teshekpuk Lake was mapped again (Markon and Derksen, 1994), but using data from the French Satellite Pour l'Observation de la Terre (SPOT).

The vegetative cover of the NPR-A has most recently been summarized in a land-cover classification developed by BLM from 1994 to 1997 in cooperation with Ducks Unlimited (DU), the FWS, and the NSB (Kempka et al., 1995; Pacific Meridian Resources, 1996). The classification was developed using Landsat TM satellite imagery. The satellite has a ground picture element (pixel) resolution of 30 m by 30 m and measures the spectral reflectance in several frequency bands. With the aid of field-verification and computer analysis, each pixel was classified into one of 7 major and 17 minor land-cover classes. These classes were distinguished from one another based on their relative composition in terms of percent cover of water, bare ground, and different plant species (Table III.B.2-1).

Carex aquatilis (water sedge) is the dominant species in the Wet Tundra class, both of the Flooded Tundra classes, and one Aquatic class which bears its name. The other Aquatic class is dominated by *Arctophila fulva*. Other common graminoid species occurring most prominently in the Moist Tundra classes are *Arctagrostis latifolia*, *Deschampsia caespitosa*, *Cochlearia officianalis*, *Poa lanata*, *Puccinellia phryganodes*, *Eriophorum angustifolium*, *Eriophorum russeolum*, and *Eriophorum vaginatum*. *Eriophorum vaginatum*, commonly referred to as tussock cotton grass, is the dominant species of the Tussock Tundra class.

Some of the commonly occurring herbaceous species are *Caltha palustris*, *Epilobium latifolium*, *Petasites frigidus*, *Potentilla palustre*, and species of the genera *Draba*, *Papaver*, *Pedicularis*, *Polygonum*, *Ranunculus*, *Rumex*, *Saxifraga*, *Senecio*, and *Stellaria*.

Common shrub species include *Alnus crispa*, *Betula nana*, *Cassiope tetragona*, *Empetrum nigrum*, *Ledum palustre*, *Rubus chamaemorus*, *Vaccinium uliginosum*, *Vaccinium vitis-idaea*, and species of the genera *Andromeda*, *Arctostaphylos*, *Dryas*, and *Salix*. *Salix*, and to a much lesser extent *Alnus*, are the dominant species of the Low and Tall Shrub classes. With the exception of *Betula*, the remainder are dwarf shrubs.

The NPR-A can be divided into three physiographic provinces that occur roughly as latitudinal bands (Wahrhaftig, 1965). From north to south, they are the Arctic Coastal Plain, the Arctic Foothills, and the Brooks Range. Most of the above species occur in all three provinces, so the relative frequency of occurrence of each species is a better distinction among provinces. Such frequency differences primarily are due to differences in moisture levels. The Arctic Coastal Plain is dominated by many lakes and very poorly drained soils, whereas the Brooks Range has few lakes and some well-drained soils.

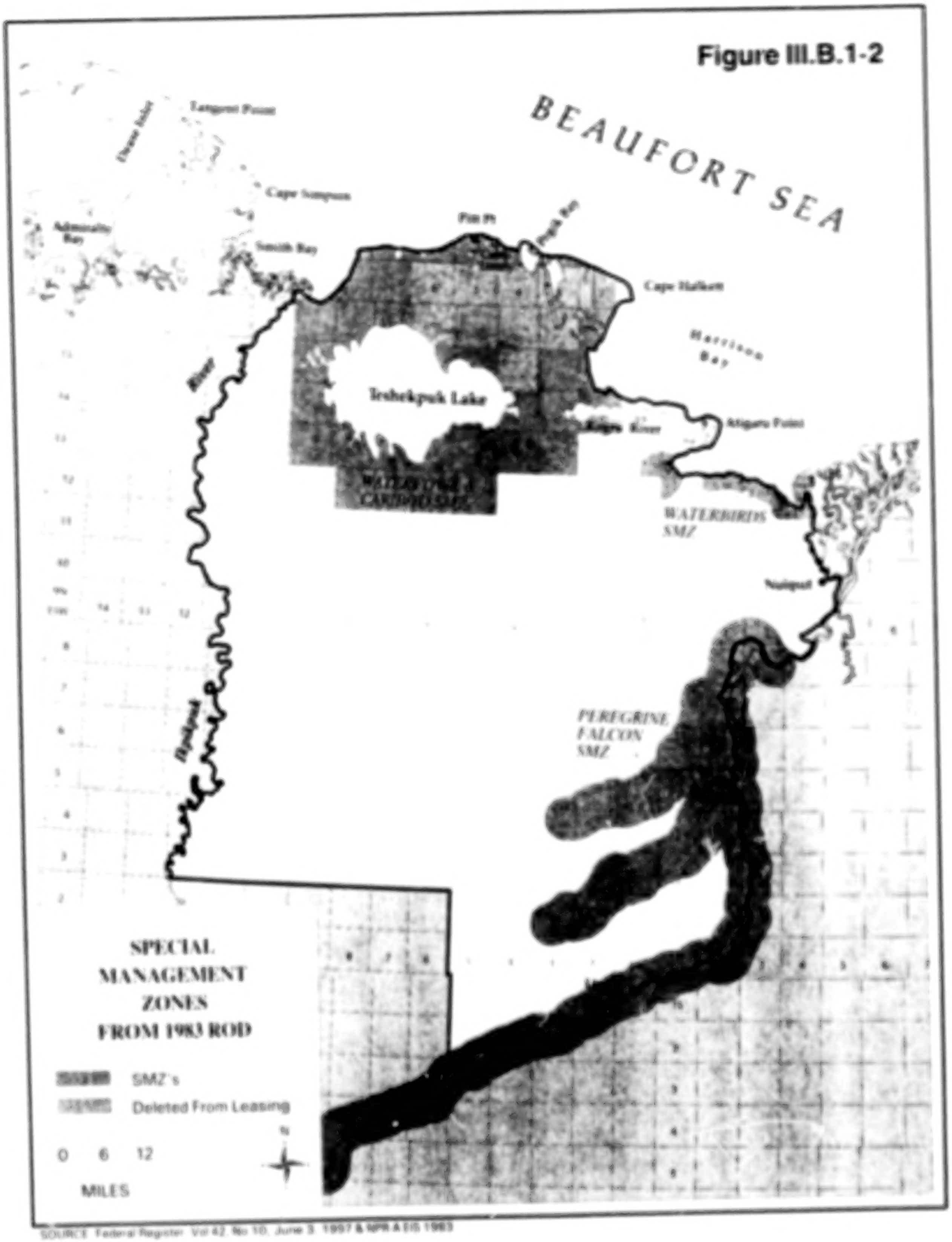
The current planning area is almost entirely within the Arctic Coastal Plain, with the exception of the southeast corner in the vicinity of Umiat, which is in the Arctic Foothills. Thus, the land cover of the planning area is characterized by many lakes and plant species that occur in saturated or poorly drained soils. Table III.B.2-1 shows the proportion of all pixels in the planning area that are classified as each of the 17 minor classes.

This summary shows that 21.4 percent of the planning area is open water, while another 18.4 percent (Aquatic, Flooded and Wet classes) has standing water with varying proportions of plant cover. The single most common cover type is the cottongrass tussock. The cottongrass form is more prevalent than it first appears from the table, because the dwarf shrub class commonly includes tussocks as well. The distinction between the Tussock Tundra and Dwarf shrub classes is based on the relative proportion of shrubs, a dominant life form. Combining these two classes suggests a total cover by tussocks in the planning area of up to 44.6 percent.

There are three species of rare vascular plants known to occur in the planning area (Lipkin, 1997). *Mertensia drummondii* has been found on sand dune habitats along the Kogosukruk River and west of the planning area along the Meade River. Five other sand dune sites within the planning area have been searched for *M. drummondii*, but none have been found (Lipkin, 1994, pers. comm.). *Potentilla stipularis* has been found at Umiat. This species occurs in sandy substrates, such as sandy meadows, and riverbank silts and sands other than dunes. *Pleuropogon sabinei* is an aquatic grass that rarely occurs between the *Arctophila* and *Carex* zones in lakes and ponds. This species is known from a few locations north and northeast of Teshekpuk Lake. Because relatively little plant survey work has been done on Alaska's North Slope, these species may occur at additional sites within and outside of the planning area. In addition, there are four other rare species known to occur on the North Slope but which have not yet been found in the planning area (Lipkin, 1997). *Draba adamsii* has been found near Barrow in eroding, turfy polygons by the ocean or streams. This species may be precluded from areas farther south by its adaptation to low temperatures. *Poa hartzii* is a grass known from sites on the Meade River and within the ANWR. It occurs on the dry sands of some active floodplains. *Erigeron muirii* may occur on some drier soils, such as ridges in the foothills region. *Aster pygmaeus* is known from sites east of the planning area on mud flats and saline soil.

3. Fish: This discussion incorporates by reference the description of fish resources contained in the Sale 124 FEIS (USDOI, MMS, 1990). It also summarizes fisheries-related information from current research pertinent to this review. For more detailed information concerning species descriptions, distributions, and collection sites/methods, please see the research cited herein. Subsistence use of fish is described in Section III.C.3.

Figure III.B.1-2



SOURCE: Federal Register, Vol 42, No 10, June 3, 1997 & NPR-A EIS 1983

BEST COPY AVAILABLE

140

Table III.B.2-1
Summary of Land Cover Inside Planning Area Boundary

Land Cover Categories MAJOR and Minor	Definition	Percent of Area
WATER	**≥80% water**	
Ice	≥80% ice	2.2
Clear water	depth >1 m and no turbidity	10.8
Turbid water	depth ≤1 m or turbid	8.4
AQUATIC	**≥50% but <80% water and >10 cm in depth**	
Carex aquatilis	>15% *Carex aquatilis*	3.8
Arctophyila fulva	>15% *Arctophyila fulva*	0.4
FLOODED TUNDRA	**≥25% but <50% water and <10 cm in depth**	
Low centered polygons	≥5% sedge/grass	6.5
Nonpatterned	<5% sedge/grass	2.7
WET TUNDRA	**≥10% but <25% water**	5.0
MOIST TUNDRA	**<10% water, <40% shrub** (mostly sedges, grasses, rushes and moss/peat/lichen)	
Sedge/grass meadow	≥50% sedge/grass and <40% tussock	10.1
Tussock tundra	≥40% tussock cotton grass	29.1
Moss/lichen	≥50% moss and/or lichen	1.6
SHRUB	**<5% water and ≥40% shrub**	
Dwarf	≤30 cm in height	15.5
Low	>30 cm but <1.5 m in height	1.7
Tall	≥1.5 m in height	0.1
BARREN GROUND	**0-30% vegetated**	
Sparsely vegetated	10-30% vegetated	0.5
Dunes/dry sand	<10% vegetation and <10% wet sand, mud or rock	0.7
Other	<10% vegetation and ≥10% wet sand, mud or rock	1.0

Fish inhabiting the Arctic must cope with harsh environmental conditions not required of their counterparts to the south. For example, during the 8- to 10-month winter period, freezing temperatures reduce their habitat by more than 95 percent. Food is very scarce during this time, so most of their yearly food supply must be acquired during the brief arctic summer (Craig, 1989). As a result, fish inhabiting the Arctic grow slowly compared to those inhabiting warmer regions (USDOI, BLM, 1990). Nevertheless, several types of fish are year-round residents in the planning area. They include (1) freshwater fish that spend either their entire life in freshwater or most of it in freshwater, except for brief periods in brackish coastal waters; (2) marine fish that spend either their entire life in marine waters or most of it in marine waters, except for brief periods in brackish coastal waters; and (3) migratory fish that routinely move between fresh, brackish, and marine waters for various purposes. While many of the studies concerning arctic fish were conducted to the east of the Colville River, several contain information applicable to the planning area. Hence, much of what is said in this review is likely to apply to areas outside the planning area.

The planning area includes an extensive freshwater environment as well as a coastal marine environment adjacent to its northern border. The freshwater environment consists of slow-moving coastal plain rivers and streams as well as lakes, ponds, and a maze of interconnecting channels (see Sec. III.A.2.a for additional information on water resources). Some bodies of water are completely isolated; however, most are permanently, seasonally, or sporadically connected. Seasonally connected lakes are flooded during breakup, while sporadically connected lakes are flooded only during high-water years (Parametrix, Inc., 1996). Many of these waters support freshwater and migratory fish populations. At least 20 species of fish have been collected in or near the Colville drainage system (11 freshwater and 9 migratory species) (Moulton and Carpenter, 1986; Bendock, 1997). The distribution and abundance of freshwater and migratory fish within the planning area depends on (1) adequate overwintering areas, (2) suitable feeding and spawning areas, and (3) access to these areas (typically provided by a network of interconnecting waterways) (Parametrix, Inc., 1996). In winter, bodies of freshwater <6 ft deep are frozen to the bottom (Craig, 1989). In deeper waters that do not freeze to the bottom, the amount of dissolved oxygen is of critical importance. Flowing waters exceeding 7 to 10 ft in depth (depending on water velocity) generally are considered deep enough to support overwintering fish. However, in standing waters the ice becomes thicker, and dissolved oxygen becomes less available as the winter progresses. In such cases, depths of up to 18 ft have been suggested as being the minimum

141

required to support overwintering freshwater fish (USDOI, BLM, 1990).

The marine environment consists of inlets, lagoons, bars, and numerous mudflats (USDOI, BLM, 1978a). During the open-water period, the nearshore zone of this area is dominated by a band of relatively warm, brackish water that extends across the entire Beaufort Sea coast. The summer distribution and abundance of coastal fish (marine and migratory species) is strongly affected by this band of brackish water, which typically extends from 1 to 6 mi offshore. It is formed after breakup by freshwater input from rivers such as the Colville and Ikpikpuk rivers, which border the planning area. It has its greatest extent off river-delta areas, with a plume sometimes extending 15 mi offshore. During the summer, migratory fish tend to concentrate in the nearshore area, which also is used by marine fish and occasionally by freshwater fish. The areas of greatest species diversity within the nearshore zone are the Colville and Ikpikpuk river deltas (Bendock, 1997). Sixty-two species of fish have been collected from the coastal waters of the Alaskan Beaufort Sea (69% marine, 26% migratory, 5% freshwater). All (except salmon) are typical of fish resident to arctic coastal waters from Siberia to Canada (Craig, 1984). Thirty-seven species were collected in the warmer nearshore brackish waters, and 40 were collected in the colder marine waters farther offshore (some use both habitats). As the summer progresses, the amount of freshwater entering the nearshore zone decreases, and nearshore waters become colder and more saline. From late summer to fall, migratory fish move back into rivers and lakes to overwinter and to spawn (if sexually mature). In winter, nearshore waters <6 ft deep freeze to the bottom. Before they do so, marine fish continue to use the nearshore area under the ice but eventually move into deeper offshore waters, when the ice freezes to the bottom (Craig, 1984).

a. Freshwater Fish: Freshwater fish inhabit many of the rivers, streams, lakes, and ponds within the planning area. They include lake trout, arctic grayling, Alaska blackfish, northern pike, longnose sucker, round whitefish, burbot, ninespine stickleback, slimy sculpin, arctic lamprey, and threespine stickleback (rare). Freshwater fish are found almost exclusively in freshwater (Moulton and Carpenter, 1986). Those with access to rivers, such as the Colville River, sometimes are found in the nearshore band of brackish coastal water described earlier. All of the above freshwater species have been collected near the mouth of the Colville River during summer (USDOI, BLM, 1978a); however, their presence in the coastal environment is sporadic and brief, with a peak occurrence expected during or immediately following spring breakup.

Many of the streams on the Arctic Coastal Plain serve as interconnecting links to myriad lakes in the planning area (Bendock, 1997). Some waters are used primarily as nursery areas, others for feeding, others for spawning and/or overwintering, and others as corridors linking these areas. Juvenile fish prefer the warmer shallow-water habitats that become available during the ice-out period (Hemming, Weber, and Winters, 1989). The most abundant freshwater fish is the ninespine stickleback (Hemming, 1996). Highest numbers are found in waters having emergent and submerged vegetation suitable for spawning and rearing, with overwintering sites nearby (Hemming, 1993). In streams, the most common freshwater fish include arctic grayling, ninespine stickleback, and slimy sculpin (Netsch et al., 1977; Bendock and Burr, 1984). Drainages having the greatest diversity of freshwater fish include the Colville and Ikpikpuk rivers and Fish Creek. In lakes, the most common freshwater fish include lake trout, arctic grayling, round whitefish, and burbot. Older lake fish usually are dominant.

Sixty-two lakes within the planning area have been sampled (Bendock and Burr, 1984). Of these, Teshekpuk Lake is reported to have the greatest species diversity (11 species) (Philo, George, and Moulton, 1993; Bendock, 1997). In general, the larger, deeper, clearer lakes with outlets and suitable spawning areas are more likely to support fish. Smaller lakes that are more shallow and turbid, without outlets or suitable spawning areas, are not likely to support fish (Netsch et al., 1977; USDOI, BLM, 1978a). Many of the lakes having fish populations are reported to be to the south and southwest of Teshekpuk Lake. Bodies of freshwater <6 ft in depth generally do not have resident fish populations, although some may be used during the summer for feeding, rearing, or as access corridors to other waters.

Freshwater fish feed on terrestrial and aquatic insects and their larvae, zooplankton, clams, snails, fish eggs, and small fish (Bendock and Burr, 1984; USDOI, BLM, 1978a; Hemming, Weber, and Winter, 1989). Lake trout and burbot are reported to forage heavily on least cisco, round whitefish, grayling, and particularly on slimy sculpin and ninespine stickleback. Lake trout also have been reported to feed on voles (USDOI, BLM, 1978b) and burbot on arctic lamprey (Bendock and Burr, 1984). Except for burbot, which spawns under ice in late winter, freshwater fish spawn from early spring to early fall in suitable gravel or rubble. With the onset of winter, freshwater fish move into the deeper areas of lakes, rivers, and streams.

b. Marine Fish: Both marine and migratory fish inhabit the coastal waters bordering the planning area. Marine fish include arctic cod, saffron cod, twohorn (uncommon) and fourhorn sculpins, Canadian eelpout, arctic flounder, capelin, Pacific herring (uncommon), Pacific sandlance (uncommon), and snailfish (Craig, 1984; Moulton and Carpenter, 1986). Marine fish prefer the

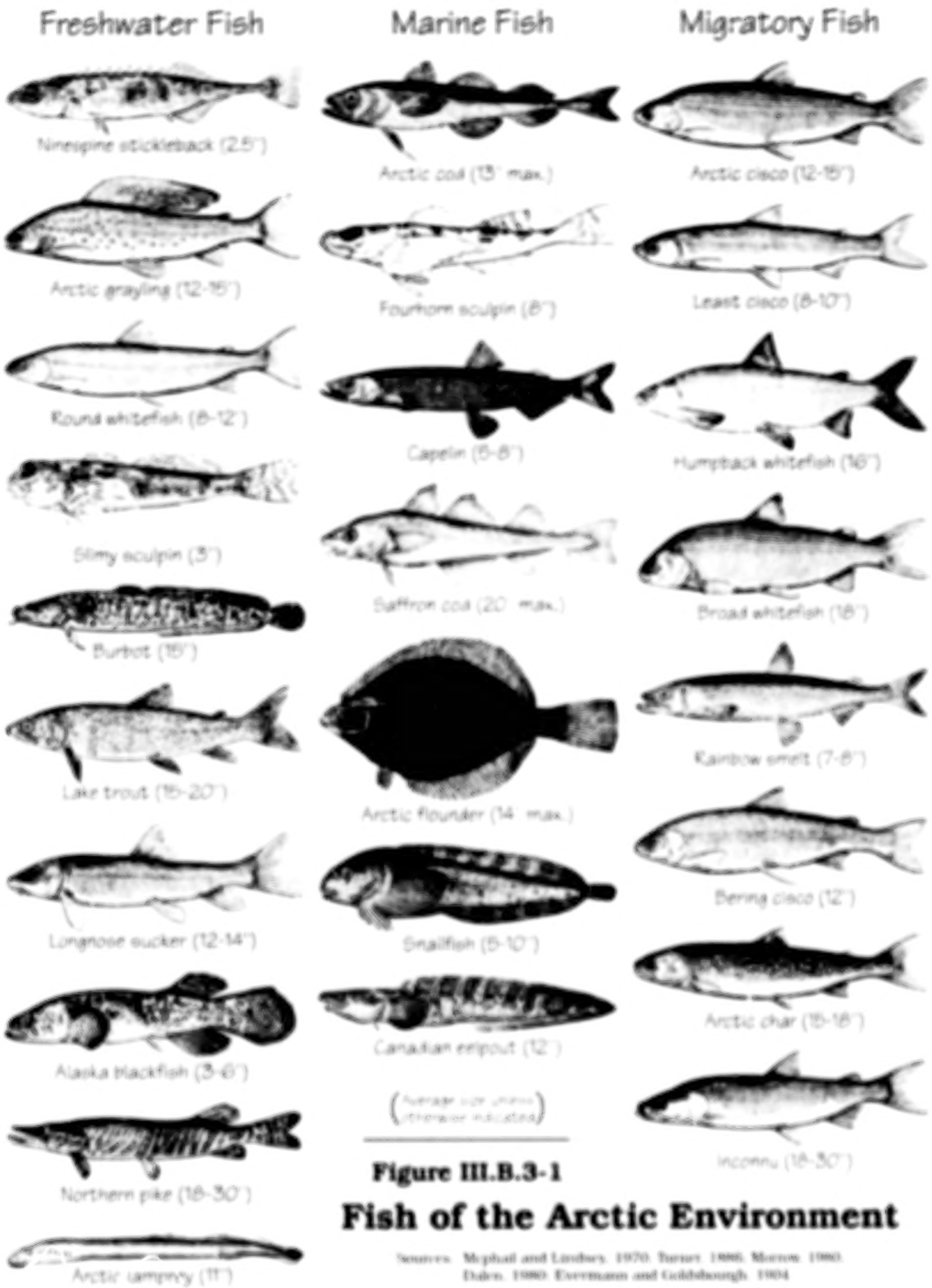


Figure III.B.3-1

Fish of the Arctic Environment

Sources: McPhail and Lindsey, 1970. Turner, 1886. Morrow, 1980. Dales, 1980. Evermann and Goldsborough, 1904 colder, more saline coastal water seaward of the nearshore brackish-water zone described earlier. As the summer progresses, the nearshore zone becomes more saline due to decreased freshwater input from rivers and streams. During this time, marine fish often share this same nearshore environment with migratory fish, primarily to feed on the abundant epibenthic fauna or to spawn (Craig, 1984). In the fall, when migratory fish have moved out of the nearshore area and into freshwater systems to spawn and overwinter, marine fish remain in the nearshore area to feed.

Common marine fish in the nearshore area include fourhorn sculpin and capelin (Schmidt, McMillan, and Gallaway, 1989; Thorsteinson, Jarvela, and Hale, 1991). Saffron cod, arctic flounder, and snailfish also use the nearshore area; however, their occurrence is sporadic and variable and in much lower numbers. Common marine fish in waters farther offshore include arctic cod and kelp snailfish (Craig, 1984; Schmidt, McMillan, and Gallaway, 1989; Thorsteinson, Jarvela, and Hale, 1991). Arctic cod have been found to be more concentrated along the interface between the warmer nearshore water and colder marine water. The warmer nearshore zone with its more moderate salinity is thought to be an essential nursery area for juvenile arctic cod (Cannon, Glass, and Prewitt, 1991). Arctic cod are abundant and contribute significantly to productivity in arctic coastal waters. Due to the significant contribution they make to the diets of marine mammals, birds, and other fish, arctic cod have been described as a "key species in the ecosystem of the Arctic Ocean" (Craig, 1984). They are believed to be the most significant consumer of secondary production in the Alaskan Beaufort Sea (Frost and Lowry, 1983) and even to influence the distribution and movements of marine mammals and seabirds (Craig, 1984, citing Finley and Gibb, 1982).

The marine fish in the planning area primarily feed on marine invertebrates. They rely heavily on epibenthic and planktonic crustacea such as amphipods, mysids, isopods, and copepods. Flounders also feed heavily on bivalve mollusks, while fourhorn sculpins supplement their diets with juvenile arctic cod. Because the feeding habits of marine fish are similar to those of migratory fish (amphidromous and anadromous species), some marine fish are believed to compete with migratory fish for the same prey resources (Craig, 1984; Fechhelm et al., 1996). Competition is most likely to occur in the nearshore brackish-water zone, particularly in or near the larger river deltas, such as the Ikpikpuk and Colville river deltas. As the nearshore ice thickens in winter, marine fish continue to feed under the ice but eventually leave as the ice freezes to the bottom some 6 ft thick. Seaward of the bottomfast ice, marine fish continue to feed and reproduce in nearshore waters all winter (Craig, 1984). Most spawn during the winter, some in shallow coastal waters, and others in offshore waters. Arctic cod spawn under the ice between November and February (Craig and Haldorson, 1981). Snailfish spawn farther offshore by attaching their adhesive eggs to a rock or kelp substrate.

c. Migratory Fish: The members of this group commonly are referred to as anadromous fish. They are born and reared in freshwater, migrate to sea as juveniles (smolts), and return to freshwater as adults to spawn and die. However, it should be noted that migratory fish indigenous to the arctic environment (amphidromous species) differ substantially from migratory fish inhabiting warmer waters to the south (anadromous species). Amphidromous fish live much longer, grow much slower, and become sexually mature much later in life. Additionally, they do not make one far-ranging ocean migration and return years later to freshwater to spawn and die. Instead, they make many migrations between freshwater and the sea, and for purposes other than just spawning. Unlike anadromous fish, amphidromous fish spend much more time in brackish coastal waters than they do in marine waters. Additionally, they return to freshwater to overwinter, not necessarily to spawn. In fact, they typically return many times to freshwater prior to reaching spawning age. Even after reaching spawning age, spawning occurs only if their nutritional requirements were met during the brief arctic summer. Lastly, when they do spawn, they do not necessarily die; many return years later to spawn again before dying. Despite these major differences, the term amphidromous seldom has been used when referring to the indigenous migratory fish of the arctic environment (Craig, 1989). For this reason and because the term anadromous is misleading, this review simply refers to this group of mostly arctic species as migratory fish.

Migratory fish inhabit many of the lakes, rivers, streams, interconnecting channels, and coastal waters of the planning area. They include arctic cisco, least cisco, Bering cisco, rainbow smelt, humpback whitefish, broad whitefish, arctic char (uncommon west of the Colville River), and inconnu. The highest concentration and diversity of migratory fish in the planning area occurs in the Ikpikpuk and Colville rivers, particularly in the river-delta areas (Bendock, 1997). Small runs of pink and chum salmon (anadromous species) sometimes occur in the Colville and Chipp rivers; however neither species has established sustained populations anywhere in the planning area (Bendock and Burr, 1984). The most common migratory fish in nearshore waters are arctic and least cisco (Craig, 1984). Lakes that are accessible to migratory fish typically are inhabited by them as well as the resident freshwater fish. Least cisco is the most abundant migratory fish found in these lakes. Surveys conducted in Teshekpuk Lake showed that >80 percent of the fish captured there

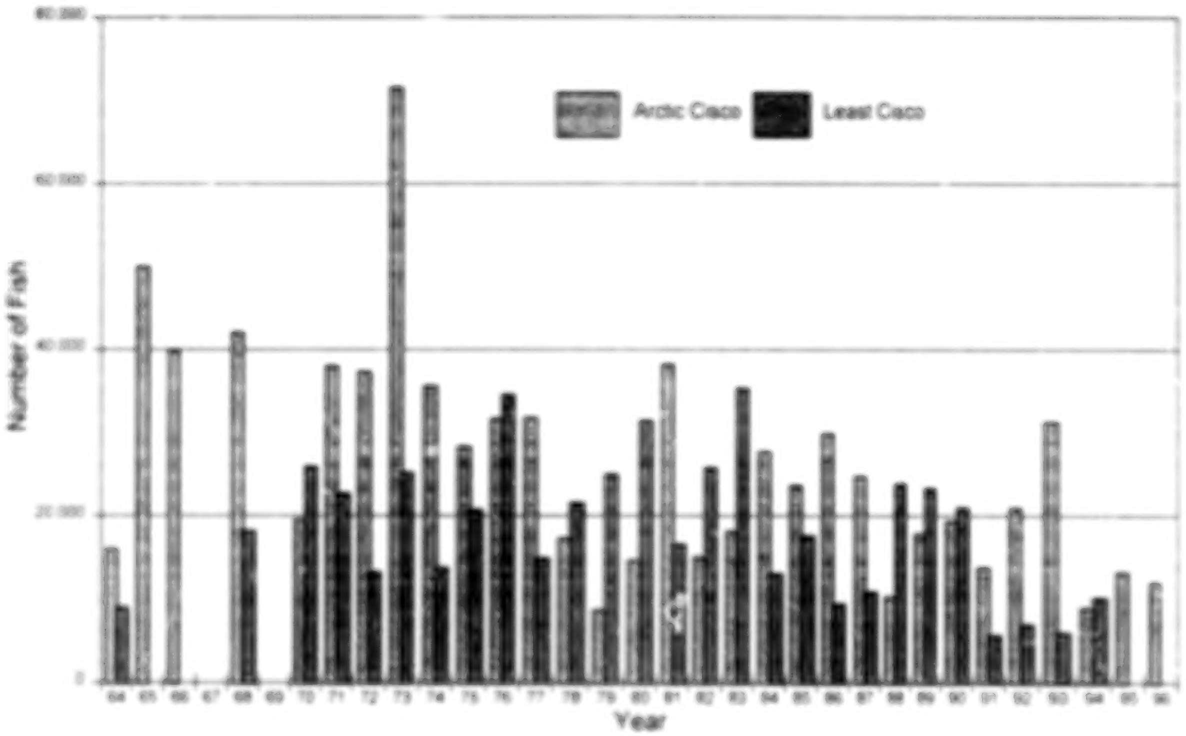


Figure III.B.3-2. Colville River Commercial Fishery, 1964–1996: Arctic Cisco and Least Cisco. Source: ADF&G, In prep.

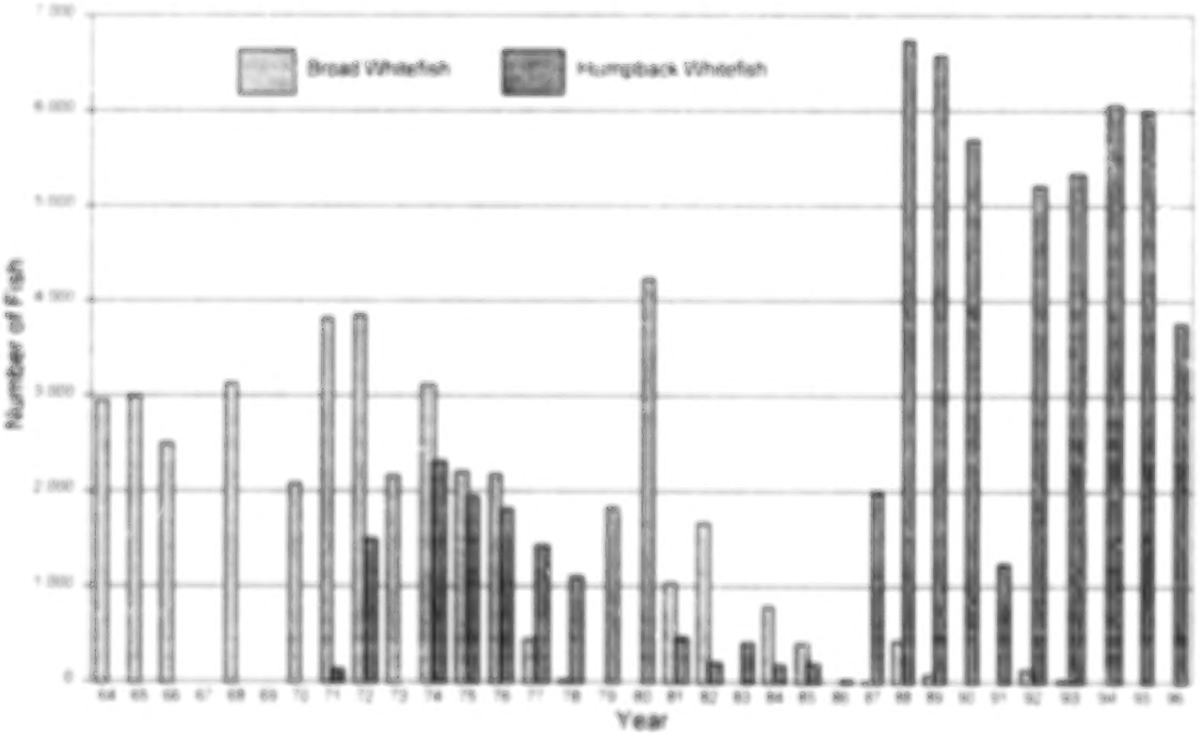


Figure III.B.3-3. Colville River Commercial Fishery, 1964–1996: Broad Whitefish and Humpback Whitefish. Source: ADF&G, In prep.

were least cisco (Bendock and Burr, 1984; Philo, George, and Moulton, 1993).

With the first signs of spring breakup (June 5-20), adult and juvenile migratory fish move out of freshwater rivers and streams and into the brackish coastal waters nearshore. They disperse in waves parallel to shore, each wave lasting a few weeks or so. Some disperse widely from their streams of origin (e.g., arctic cisco and some arctic char). Others, like broad and humpback whitefish and least cisco, do not; and they are seldom found anywhere but near the mainland shore (Craig, 1984). Most migratory fish initiate relatively long and complex annual migrations to and from coastal waters (Bendock, 1997). However, some populations of arctic char, least cisco, and broad and humpback whitefish never leave freshwater (Craig, 1989). Many believe that arctic cisco in the Colville River area originated from Mackenzie River spawning stocks in Canada (Thorsteinson and Wilson, 1996). However, there are reports from fishermen that arctic cisco in spawning condition have been caught in at least the upper Colville and Chipp rivers (Moulton, Fawcett, and Carpenter, 1985, citing W. Matumeak, North Slope Borough, pers. comm., 1984).

During the 3- to 4-month open-water season that follows spring breakup, migratory fish accumulate energy reserves for overwintering and, if sexually mature, spawning. They prefer the nearshore brackish-water zone, rather than the colder, more saline waters farther offshore. While their prey is concentrated in the nearshore zone, their preference for this area is believed to be more correlated with its warmer temperature and lower salinity (Moulton, Fawcett, and Carpenter, 1985). Migratory fish are more abundant along the mainland and island shorelines, but they also inhabit the central waters of bays and lagoons. Larger fish of the same species are more tolerant of colder water (e.g., arctic char and arctic and least ciscoes) and range farther offshore (Moulton, Fawcett, and Carpenter, 1985; Thorsteinson, Jarvela, and Hale, 1991). Smaller fish are more abundant in warmer, nearshore waters and the small, freshwater streams draining into the Beaufort Sea (Hemming, 1993).

Infaunal prey density in the nearshore substrate is very low and provides little to no food for migratory fish. However, prey density in the nearshore water column is high, about five times that of freshwater habitats on the Arctic Coastal Plain. The nearshore feeding area also is much larger than that of freshwater habitats on the coastal plain (Craig, 1989). For these reasons, both marine and migratory fish come to feed on the relatively abundant prey found in nearshore waters during summer. Migratory fish feed on epibenthic mysids and amphipods (often >90% of their diet) and on copepods, fish, and insect larvae (Craig and Haldorson, 1981; Craig et al., 1984; Craig, 1989). In early to midsummer when migratory fish are most abundant in nearshore waters, little dietary overlap is observed among them. However, in late summer when they are less abundant and their prey is more abundant, dietary overlap is common in nearshore waters (Moulton, Fawcett, and Carpenter, 1985). Migratory fish do little to no feeding during their migration back to freshwater and when spawning, but some resume feeding during winter. Arctic and least ciscoes and whitefish overwintering in the Colville River delta feed on amphipods, mysids, and fish eggs (Craig and Haldorson, 1981; Craig, 1989).

Most migratory fish return to freshwater habitats in the late summer or fall to overwinter and, if sexually mature, to spawn. Others, like cisco and whitefish, return much earlier, arriving 6 to 10 weeks before spawning starts, thus forfeiting about half of the nearshore-feeding period (Craig, 1989). Spawning in the arctic environment can occur only where there is an ample supply of oxygenated water during winter. Because of this and the fact that few potential spawning sites can meet this requirement, spawning often occurs in or near the same area where fish overwinter (Craig, 1989). For example, the Colville and Ikpikpuk rivers are known to have spawning and overwintering populations of arctic and least cisco, broad and humpback whitefish, and rainbow smelt (Craig, 1984; Bendock and Burr, 1984; Parametrix, Inc., 1996). All are fall spawners except for smelt, which spawn in the spring. Arctic char and Bering cisco also overwinter in the Colville River. Least cisco also spawn in lakes having suitable spawning and overwintering sites (Bendock and Burr, 1984).

d. Commercial Fishing: The planning area supports the only registered commercial-fishing operation on the North Slope. It is operated by the Helmericks family from summer through fall in the Colville River delta. The fishery consists of arctic and least cisco, and broad and humpback whitefish. Arctic cisco is the most profitable fish. This species, along with broad and humpback whitefish, is sold for human consumption in Fairbanks and Barrow. Least cisco also are taken in large numbers and sold for dogfood. Annual commercial catches of arctic and least cisco and of broad and humpback whitefish are shown in Figures III.B.3-2 and 3-3 (State of Alaska, Dept. of Fish and Game, In prep.)

In estimating the effect of commercial fishing on arctic and least cisco, it is generally assumed that most of the harvestable population moves into the Colville River by fall and is vulnerable to the commercial fishery. Based on this assumption, the annual commercial harvest of arctic and least cisco is estimated to represent <10 percent of the harvestable population (Moulton and Field, 1988). However, due to the probable eastward movement of some arctic cisco into Canadian waters, the commercial-harvest rate for this species may be higher. For example, the commercial-harvest rate for arctic cisco in 1985 was estimated to be 6 percent of the harvestable population. If only 50 percent of the harvestable arctic cisco were vulnerable to the Colville River commercial fishery (for whatever reason), the actual commercial-harvest rate would have been closer to 12 percent of the harvestable population (Moulton and Field, 1988).

4. Birds: About 75 bird species are expected to occur annually in the planning Aaea or adjacent nearshore (less than or equal to [≤] 20 m depth) Beaufort Sea habitats. Nearly all these species, which include loons, waterfowl, shorebirds, passerines, raptors, and seabirds, are migratory and present only within the period May to November. Among surveyed waterbird groups, Pacific loon, greater white-fronted goose, molting brant and Canada goose, northern pintail, scaup, and oldsquaw are the most abundant species in the planning area (Table III.B.4-1), but substantial numbers of king eider, glaucous gull, and arctic tern also are abundant. Accurate census figures are lacking, but several shorebird species (Table III.B.4-3) and presumably passerines other than the Lapland longspur probably are present at comparable abundance levels. Although breeding waterbirds are rather evenly dispersed over the planning area, overlaps of areas where four or more species occur at high density are located north and southwest of Teshekpuk Lake, near Cape Halkett, north of Nuiqsut, and in the eastcentral planning area (Fig. III.B.4-1).

Habitat Types: Derksen, Rothe, and Eldridge (1981) examined the relation of bird distribution to habitat use based on the wetland classification system of Bergman et al. (1977), further refined by Markon and Derksen (1994) and Pacific Meridian Resources (1996). Ponds and lakes are classified on the basis of water depth and presence of the emergent sedge *Carex aquatilis* and emergent grass *Arctophila fulva*. Shallow-*Carex* ponds are <30 centimeters (cm) deep and lack *Arctophila*; shallow-*Arctophila* ponds contain this species throughout and typically are <50 cm deep, whereas the central zone of deep-*Arctophila* ponds (>40 cm deep) is unvegetated. Deep-open lakes lack substantial emergent vegetation. In the BLM/DU land-cover classification scheme presented in Table III.B.2-1 wetlands with emergent vegetation are distinguished by the species above in the "Aquatic" category; beaded stream, aquatic sedge or grass marsh, and wetter portions of saltmarsh habitat of other authors (e.g., Derksen, Rothe, and Eldridge, 1981; Johnson et al., 1996) also would be included here. Portions of ponds and lakes (and tidal sloughs) without emergent vegetation are classified as "water" in the BLM/DU scheme. Bergman et al. (1977) also recognized basin-complex wetlands which are partially drained basins that contain a mosaic of wetland types. Nonaquatic habitat types of other classification systems, such as moist sedge-grass meadows and tussock tundra, are in the BLM/DU moist tundra category; shrub communities are equivalent; salt-killed tundra and wet sedge-willow are included in the Wet Tundra category; and tidal flats are included as a type of barren ground.

Important Bird Habitats: Bergman et al. (1977) found deep-*Arctophila* ponds and lakes, basin-complex wetlands, and coastal wetlands (saline influenced habitats) used most intensively by waterbirds near Prudhoe Bay. Derksen, Rothe, and Eldridge (1981) also observed greater use of wetlands containing *Arctophila* by various waterbirds (e.g., loons, brant, oldsquaw, scoter, king eider) than other habitats at study sites in the planning area. *Arctophila* habitats account for only 0.4 percent of the planning area (Table III.B.2-1) suggesting their importance is much greater than their presence would indicate. Deep-open lakes are important to diving species that nest in the planning area (loons, oldsquaw, scaup) because of the availability of prey (invertebrates and fish); such lakes north and east of Teshekpuk Lake are used annually by large numbers of molting geese (discussed below). Coastal wetlands have been identified as important habitat for staging shorebirds, waterfowl, and longspurs (Andres, 1994; Bergman et al., 1977; Martin and Moiteret, 1981; TERA, 1994). The Colville River corridor, forming the eastern planning area boundary, contains the most extensive tall shrub stands on the arctic slope; this habitat type, representing only 0.1 percent of the planning area, is essential for a variety of passerine species most of which have a limited distribution on the arctic slope. Dry tundra, usually limited in distribution at coastal plain sites, is used preferentially by some species such as American golden-plover and buff-breasted sandpiper (Lanctot and Laredo, 1994; TERA, 1994).

Goose-Molting Habitat: The goose-molting habitat area is located north and east of Teshekpuk Lake (Fig. II.B.2) in the Teshekpuk Lake Special Area (Fig. 1.5). This area is 513,025 acres (2.08×10^3 km^2) in extent, enclosing the 200 regularly used lakes that attract 18,500 to 68,500 (15 yr $\bar{x}$ = 37,827) brant, and greater white-fronted, Canada, and snow geese (King and Hodges, 1979; King, 1997; King, 1997a, pers. comm.) during their wing molt when they are flightless for several weeks each summer. Annual counts from aerial surveys (Table III.B.4-2) indicate the relative importance of these lakes to the four species combined (Fig. III.B.4-2). While more is known about brant use of this area than the other species, the broad features of use are applicable to all molting geese. The goose molting area is characterized by the presence of large lake basins that undergo cycles of lake formation and drainage (Britton, 1967; Weller and Derksen, 1979). Characteristics of the lake habitat that are hypothesized to attract molting geese to this area include: (1) the presence of large deep lakes

Table III.B.4-1
Status, Occurrence, and Estimated Numbers and Densities of Selected Bird Species on the Arctic Coastal Plain

Common Name	Status	Occurrence	Estimated Coastal Plain Population (mean)	Estimated Planning Area Population	Estimated Breeding Period Density (birds/km²)
LOONS/WATERFOWL					
Red-throated Loon	C	early June–late September	2,441	533	0.04
Pacific Loon	C	late May–late September	28,612	6,309	0.41
Yellow-billed Loon	U	mid May–mid September	3,685	898	0.06
Tundra Swan	C	mid May–early October	9,004	1,821	0.14
Greater White-front. Goose	C	mid May–mid September	102,051	16,740	0.8-3.1
Molting				7,024	
Brant	FC	late May–early September	8,456	17,570	
Molting		late June–early August			
Canada Goose (molting)	FC	early June–late July		13,001	
Northern Pintail	A	late May–mid September	214,706	49,564	3.4
Scaup	C	late May–mid-September	32,707	8,864	0.5
King Eider	A	late May–October	11,911	3,899	0.3
Oldsquaw	A	late May–mid October	116,875	22,056	1.8
Scoters	C	late May–early September	13,294	1,357	0.2
PASSERINES					
Common Raven	U	Resident			
Lapland Longspur	A	mid May–early September			24.3-64.2
RAPTORS					
Arctic Peregrine Falcon	U	mid-April–mid September			
Gyrfalcon	FC	Resident	100		
Rough-legged Hawk	U	late April–early October	600-1,000		
SEABIRDS					
Glaucous Gull	C	early May–November	15,009	2,882	0.2
Sabine's Gull	U	late May–early September	9,668	1,819	0.1
Arctic Tern	FC	late May–early September	20,710	5,608	0.3
Jaegers	FC	late May–mid-September	6,774	1,357	0.1
OTHER					
Ptarmigan	C	Resident			4.0-9.0

Sources: Derksen, Rothe, and Eldridge 1981; Johnson and Herter 1989; King 1997 pers. commun.; Larned et al. 1997
A = Abundant; C = Common; FC = Fairly Common; U = Uncommon; Resident = Present throughout the year (ARCO 1996)

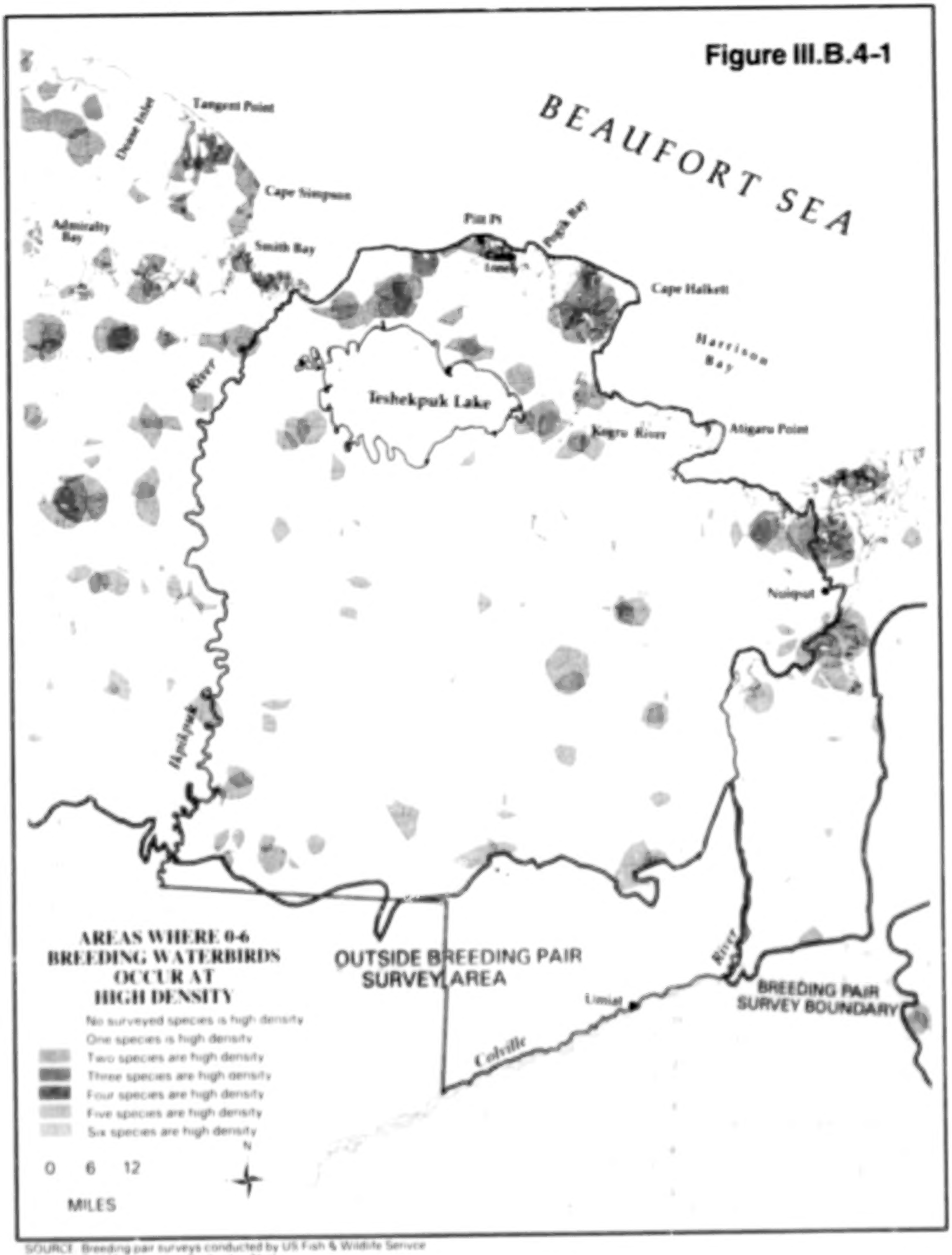
Table III.B.4-2
Numbers of Geese Recorded in the Teshekpuk Lake Goose Molting Habitat Area During Aerial Surveys over a 15-Year Period

Numbers Counted	All Geese	Brant	Greater White-Front. Goose	Canada Goose	Snow Goose
Max. in any Year	58,484	27,035	27,710	26,681	419
Max. on any Lake	6,770	4,745	4,020	2,935	225
Mean for All Lakes	37,827	17,570	7,024	13,001	232
High Mean at any Lake	3,386	2,505	513	1,018	20

Source: King 1997a

148

Figure III.B.4-1


BEAUFORT SEA
Tangent Point
Dease Inlet
Cape Simpson
Admiralty Bay
Smith Bay
Pitt Pt
Pogik Bay
Lonely
Cape Halkett
Harrison Bay
Teshekpuk Lake
Kogru River
Atigaru Point
Nuiqsut
Ikpikpuk River
Colville River
Umiat
OUTSIDE BREEDING PAIR SURVEY AREA
BREEDING PAIR SURVEY BOUNDARY
AREAS WHERE 0-6 BREEDING WATERBIRDS OCCUR AT HIGH DENSITY
No surveyed species is high density
One species is high density
Two species are high density
Three species are high density
Four species are high density
Five species are high density
Six species are high density
N
0 6 12
MILES

SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

Table III.B.4-3
Approximate Chronology of Activities for Selected Birds Nesting on the Arctic Coastal Plain

Species or Group	Arrival in Nesting Area	Egg Laying	Hatch	Brood Rearing	Adult Molt	Fall Migration
Loons	late May– early June	mid June– late June	mid July– late July	mid July– early September	Winter	late August– September
Tundra Swan	mid May– late May	late May– early June	late June– early July	late June– mid September	mid July–August	late September– early October
Brant	late May– early June	early June– late June	late June– mid July	late June– early September	–mid August[1]	mid August– early September
Greater White-Fronted Goose	mid May– early June	late May– mid June	late June– early July	late June– late August	mid July– early August[2]	mid August– mid September
Northern Pintail Males	late May	mid June– late June	early July– late July	early July– early September		early August– mid September[4]
Oldsquaw	late May	late June– early July	mid July– late July	mid July– early September	late July– early September[3]	late September– October

Sources

[1] Nonbreeding, failed breeder molt-migrant brant, late June-early August

[2] Nonbreeding young of the previous year and failed breeders molt late June.

[3] Includes males, nonbreeders, failed breeders, as well as females with broods

[4] Male pintails depart early July.

Table III.B.4-4
Breeding Status, Relative Abundance on the Arctic Coastal Plain, and Range of Estimated Densities for Shorebird Species Expected to Breed in the NE NPR-A Planning Area

Species	Status	Relative Abundance	Density (birds/km^2)
Semipalmated Plover	PB	U	
Black-bellied Plover	B	C	1.1–4.4
American Golden Plover	B	C	0.6–4.1
Bar-tailed Godwit	B	U	0.1–1.2
Whimbrel	PB	U	
Spotted Sandpiper	PB	U	
Red-necked Phalarope	B	C	1.0–16.8
Red Phalarope	B	C	0.3–32.5
Long-billed Dowitcher	B	U	0.4–5.8
Stilt Sandpiper	B	U	3–3
Common Snipe	PB	U	0–3
Ruddy Turnstone	B	FC	0.2–0.3
Dunlin	B	C	0.2–16.0
Semipalmated Sandpiper	B	A	1.4–15.5
Least Sandpiper	PB	U	
Baird's Sandpiper	PB	FC	0–1
Pectoral Sandpiper	B	C	11.6–36.3
Buff-breasted Sandpiper	B	U	0–3

Sources: Derksen, Rothe, and Eldridge, 1981; Johnson and Herter, 1989

B = Breeding, PB = Probable breeder

A = Abundant, C = Common, FC = Fairly Common, U = Uncommon (ARCO, 1996, Appendix I-2, Table 1) with persistent ice floes, providing refuge from terrestrial predators; (2) availability of shorelines with relatively low relief that allow predator detection; (3) presence of an extensive peat/mud zone for resting, and extensive meadows of high-quality sedges, grasses, and mosses for feeding; (4) relatively low predator populations; (5) low levels of human disturbance; and (6) proximity to coastal staging areas (Derksen, Eldridge, and Weller, 1982; Derksen, Weller, and Eldridge, 1979). The unique attractiveness of this area is hypothesized to result primarily from the presence of large, frequently drained lake basins that provide extensive meadows of preferred high quality forage conveniently located in a coastal area, in combination with other features noted above, and makes it unlikely that it could be replaced by other areas (Derksen, Eldridge, and Weller, 1982). The numbers of brant and total for all geese using this area exceed that of any other known molting area.

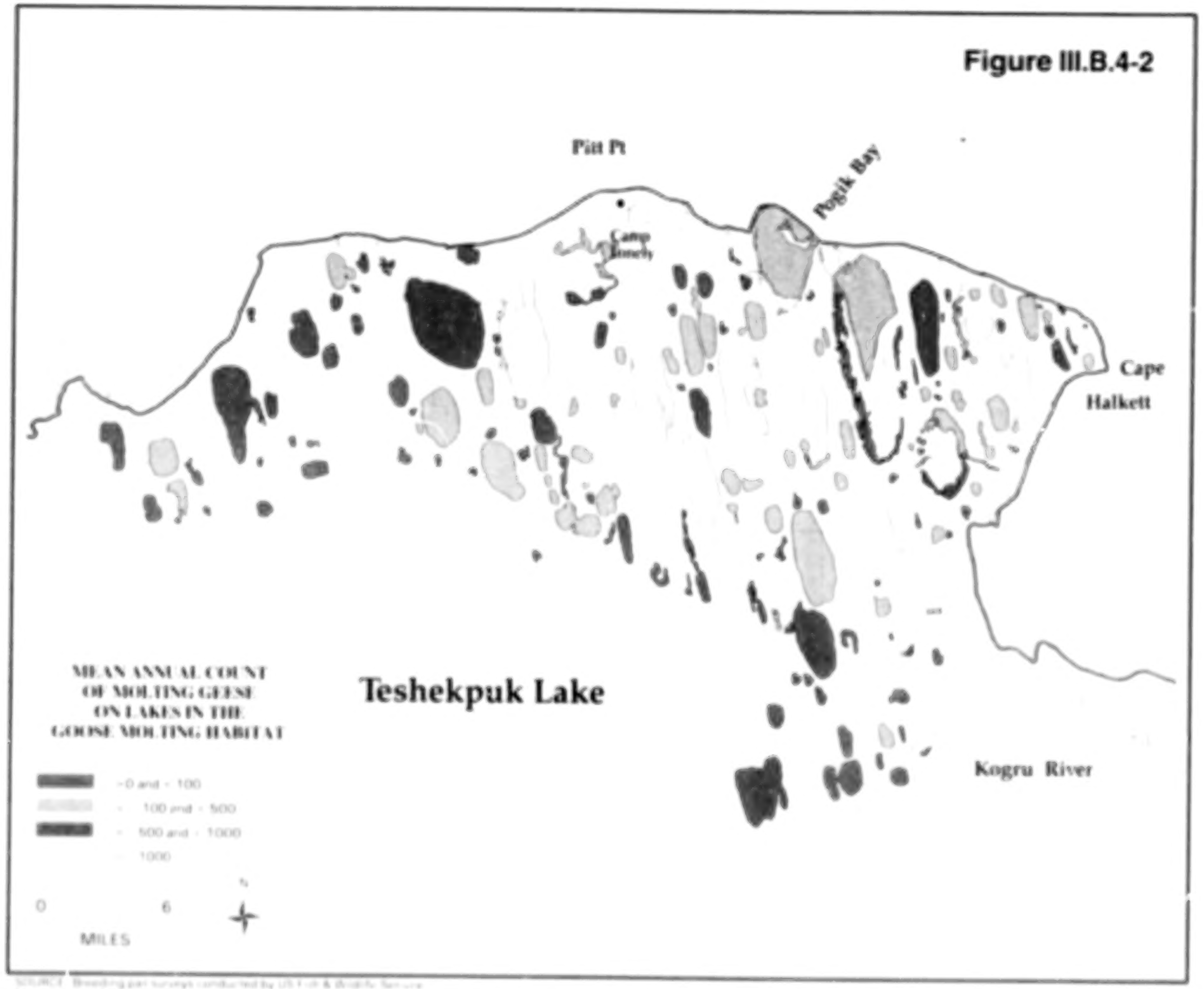
a. Loons and Waterfowl: Among the 22 species in this grouping that occur on the coastal plain, 15 are fairly common to abundant breeders in the planning area. In particular, substantial proportions of coastal plain Pacific loon, red-throated loon, yellow-billed loon, tundra swan, northern pintail, oldsquaw, scaup, and king eider populations breed in this area.

(1) Loons: On the Arctic Coastal Plain, yellow-billed loons are uncommon breeders, and Pacific and red-throated loons are common breeders. Population estimates derived from aerial breeding-pair surveys between 1992 and 1996 indicate Pacific loons are the most abundant species, but substantial numbers of yellow-billed loons also occur in the planning area (Table III.B.4-1). The planning area (24% of arctic slope breeding pair survey area) appears relatively more important to yellow-billed (27% of surveyed population occupies the planning area, Table III.B.4-1) than to Pacific loons (20%). All three species are more abundant west of the planning area. Loons arrive in early-melting areas off the Colville and other river deltas from late May to early June, depending on the species (Table III.B.4-3; Bergman et al., 1977; Johnson and Herter, 1989; North, 1994; Schamel, 1978), moving to the nesting areas as soon as those areas are free of ice and snow. Most loons have completed nesting by early August; postbreeding loons move to the coast beginning in late August and depart for wintering areas along coastal routes through September (Table III.B.4-3; North, 1994; Johnson and Herter, 1989). The primary nesting area for the U.S. population of yellow-billed loons is within the NPR-A, extending particularly between the Colville and Meade rivers, with highest densities southwest of Smith Bay, along the Alaktak and Chipp rivers, and on the Colville River and Fish Creek deltas (Fig. III.B.4-3; Brackney and King, 1996; King, 1997a, pers. comm.; King and Brackney, 1997; North and Ryan, 1988). Derksen, Rothe, and Eldridge (1981) estimated density at Square Lake in the southern planning area to be 0.10 birds/km^2 in 1978, somewhat greater than the value derived from 1992-1996 data (Table III.B.4-1). Deep-*Arctophila* lakes 50 cm or more in depth ranging in size from 74.1 to 123.5 acres (30-50 hectares) are used most frequently by nesting yellow-billed loons (North and Ryan, 1989). Pacific loons are widespread on the arctic coastal plain, with most higher density areas located west of the Ikpikpuk River. Density in the planning area (Fig. III.B.4-4) was lower than at three sites in the northeastern NPR-A in 1977 to 1978, where it varied from 0.8 to 1.5 birds/km^2 (Derksen, Rothe, and Eldridge, 1981). This species also prefers deeper *Arctophila* wetlands, with deep open lakes used in the brood-rearing period. Red-throated loons are present between the Meade and Colville rivers at lower density and more scattered distribution than yellow-billed loons (Fig. III.B.4-5). Density in the Teshekpuk Lake area ranged from 0.1 to 1.3 birds/km^2 in a 1977 to 1978 study (Derksen, Rothe, and Eldridge, 1981), much higher than recent surveys have indicated (Table III.B.4-1). Red-throated loons prefer shallow *Arctophila* lakes for nesting that are smaller (< 3 acres) than those used by other loon species, as well as beaded stream habitat (Bergman and Derksen, 1977).

(2) Tundra Swan: Recent aerial breeding-pair surveys on the Arctic Coastal Plain (1992-96) indicated about 20 percent of the coastal plain population occupies the planning area (Table III.B.4-1; King, 1997a, pers. comm.). High-density areas are mainly to the east of Teshekpuk Lake (Fig. III.B.4-6). Spring-migrant swans that will nest along the coastal plain follow the Beaufort Sea coast from the east, arriving from mid- to late May and remaining until early October (Table III.B.4-3; Hawkins, 1986; Renken, North, and Simpson, 1983; Wilk, 1987). A variety of aquatic habitats are chosen for nesting, the most important appear to be deeper *Arctophila* wetlands (Derksen, Rothe, and Eldridge, 1981). Following hatch, the young are attended by both parents; on the Colville delta, *Arctophila* and *Carex* wetlands and deeper open lakes appear to be the most important brood-rearing habitats (Johnson et al., 1996). Family groups apparently move considerable distances (>1 km) between lakes (Scott, 1972). A large flock of nonbreeding swans was observed on the Colville delta in June 1996 (Johnson et al., 1997), and fall-staging flocks of 350 to 400+ also occur (Johnson, et al., 1996). Adult molt occurs especially on deeper open lakes from mid-July through August (Table III.B.4-3), with a flightless period of about 33 days (Earnst, 1992).

(3) Brant: Both breeding and nonbreeder failed breeder components of the brant population occupy coastal habitats in the planning area. Recent population estimates based on aerial surveys (Table III.B.4-1) also include a large number of molting birds. Breeding pairs arrive in late

Figure III.B.4-2



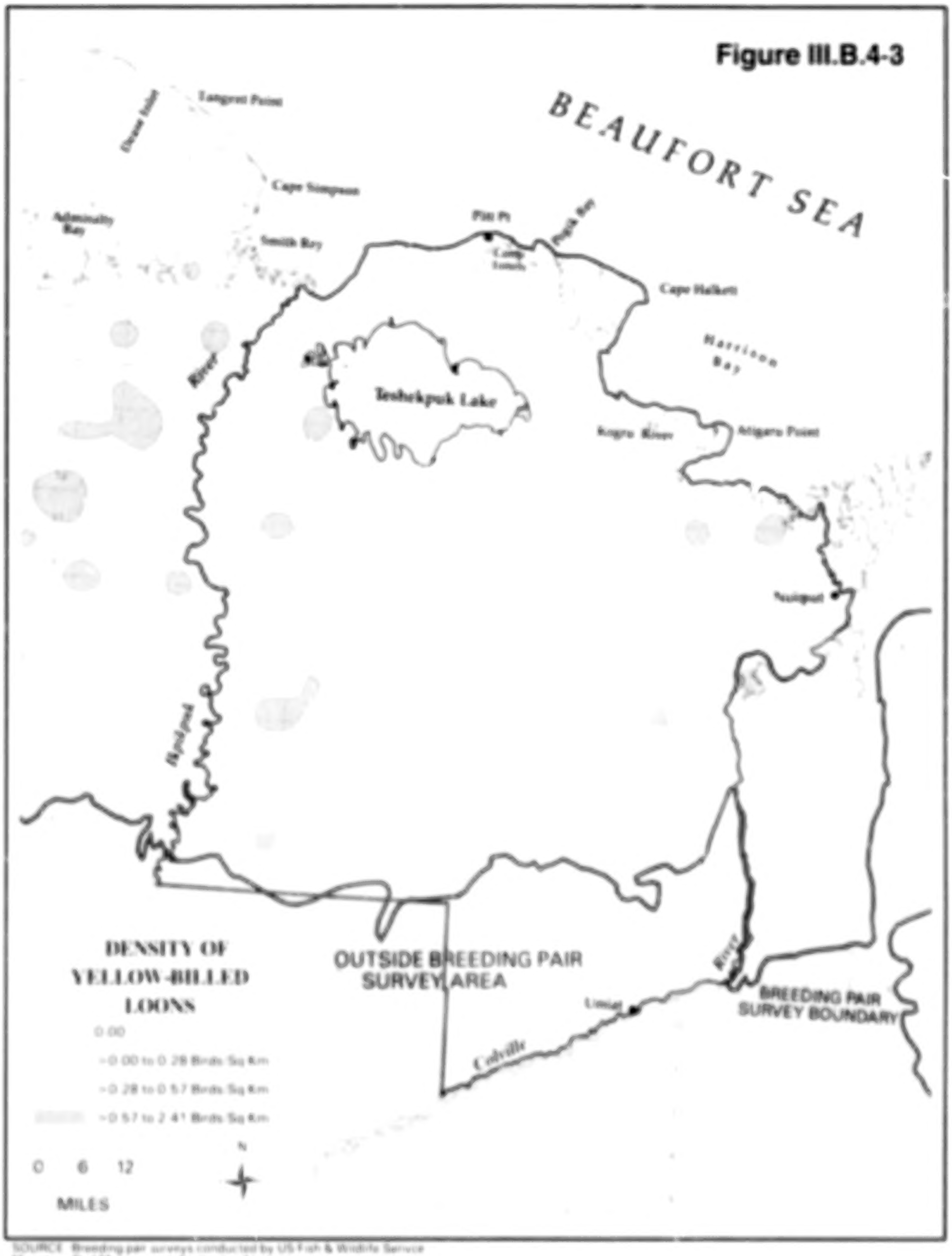
SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

152

BLANK PAGE

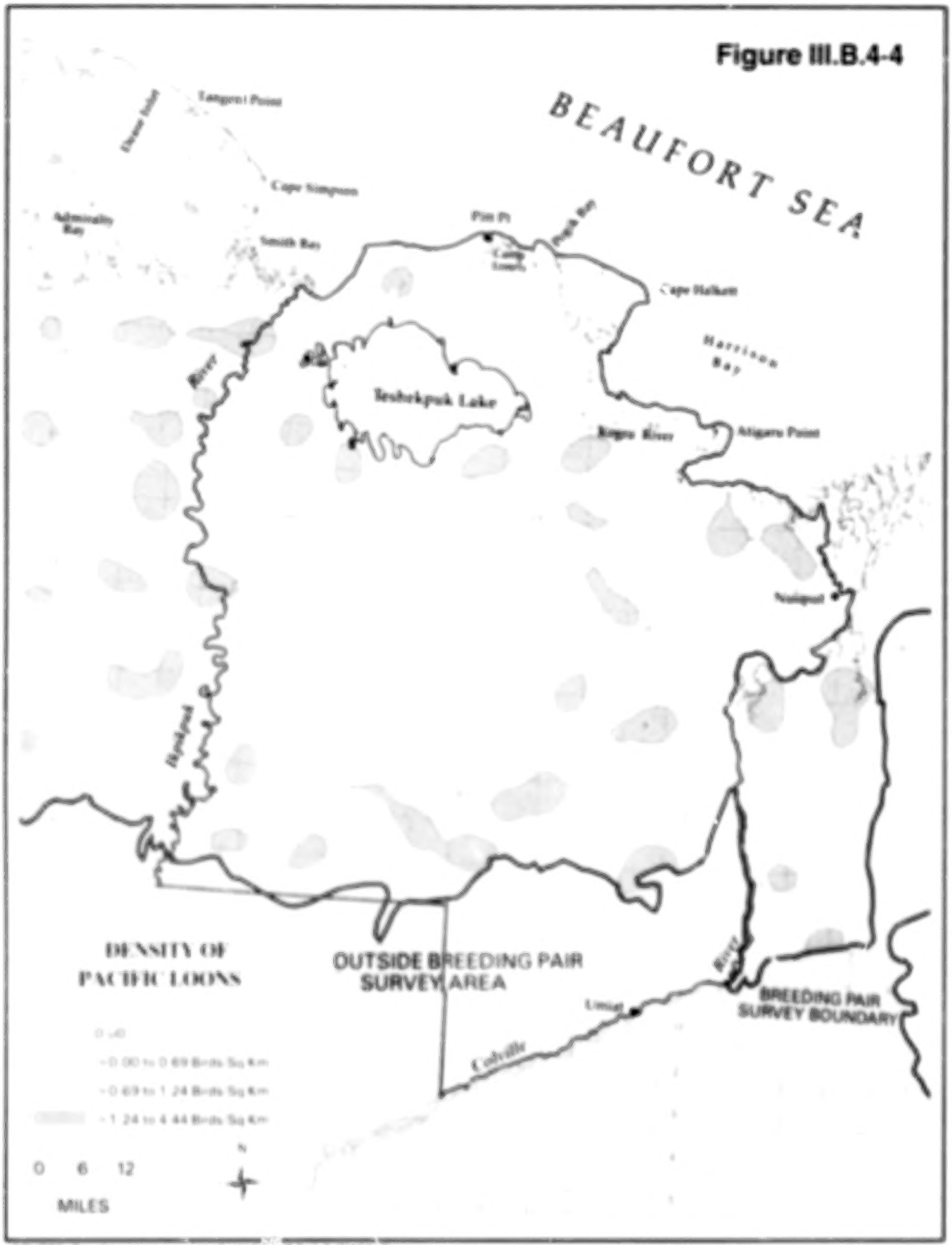
Figure III.B.4-3



SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service
Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

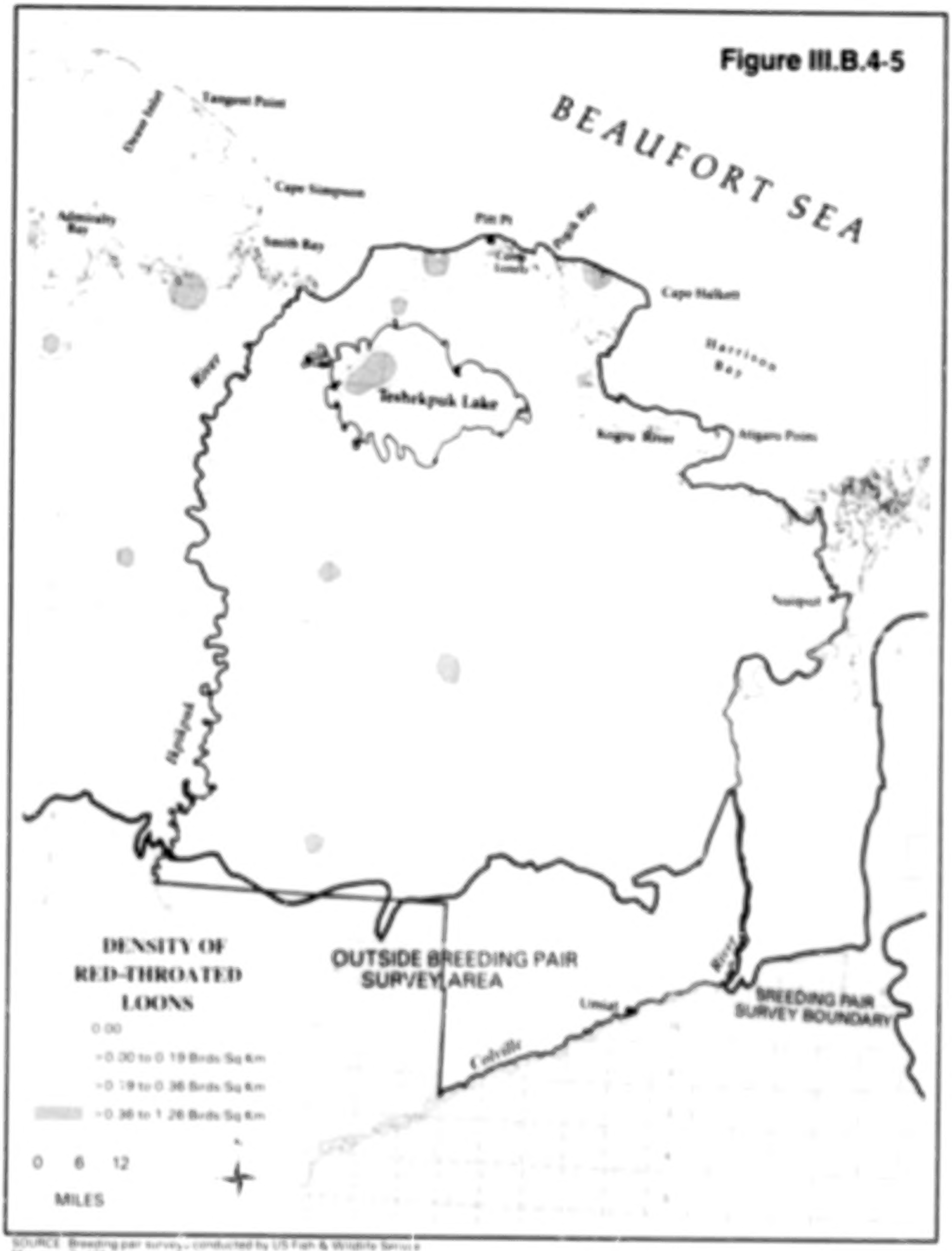
Figure III.B.4-4



SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service
Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

Figure III.B.4-5

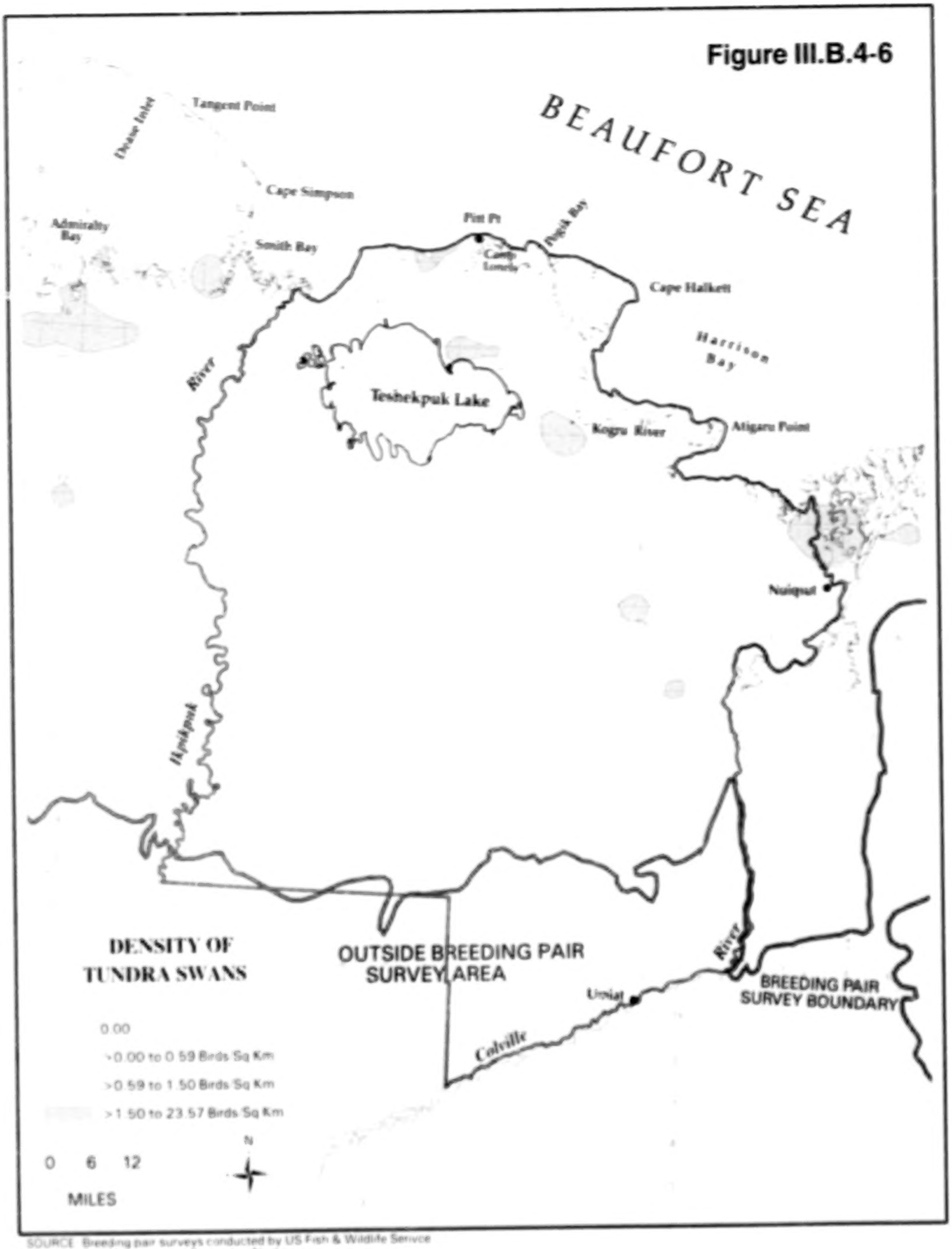


SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

BLANK PAGE

Figure III.B.4-6

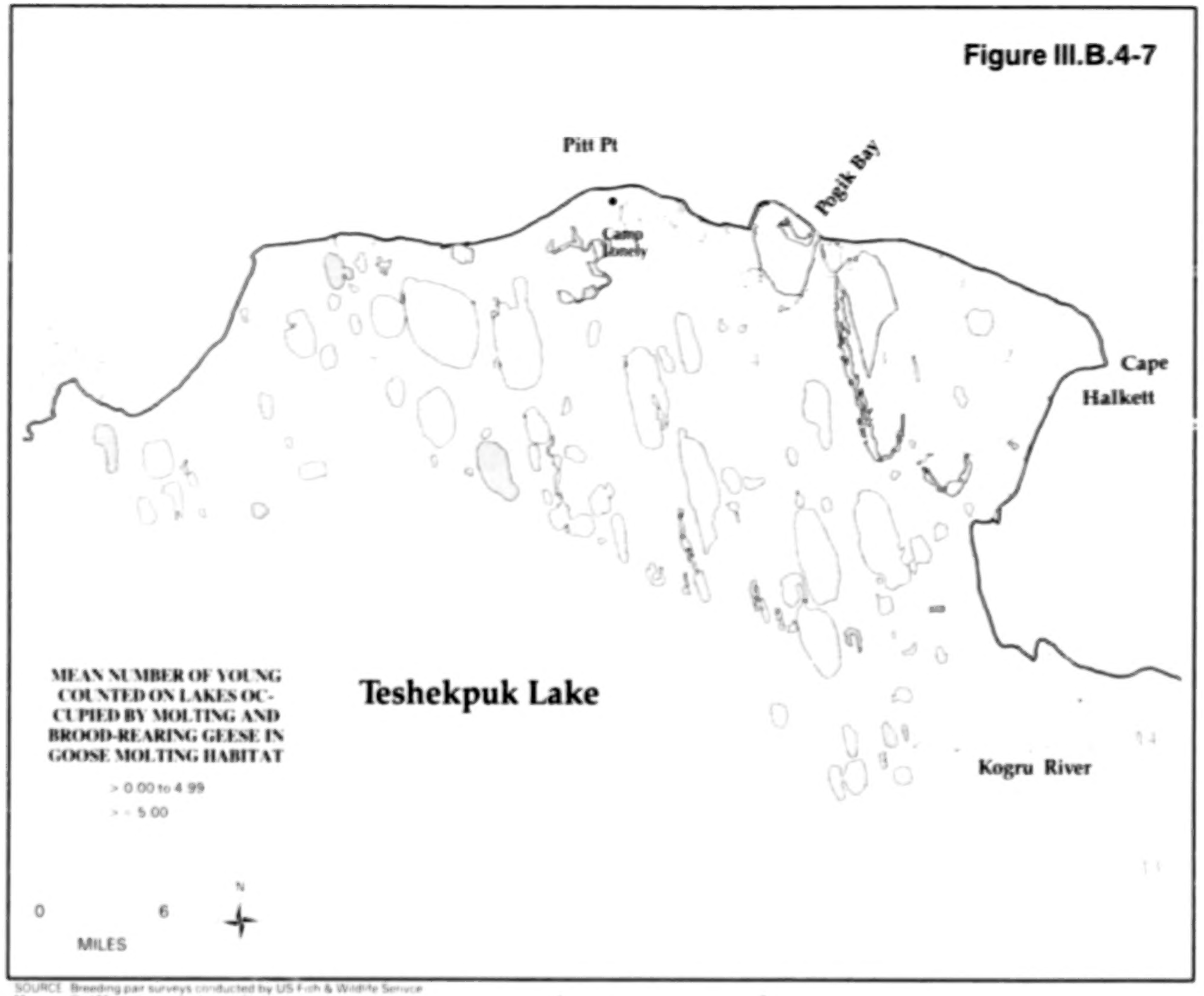


SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

BLANK PAGE

Figure III.B.4-7


Pitt Pt
Pogik Bay
Camp Lonely
Cape Halkett
Teshekpuk Lake
Kogru River
MEAN NUMBER OF YOUNG COUNTED ON LAKES OCCUPIED BY MOLTING AND BROOD-REARING GEESE IN GOOSE MOLTING HABITAT
> 0.00 to 4.99
>= 5.00
0
6
MILES
N

SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

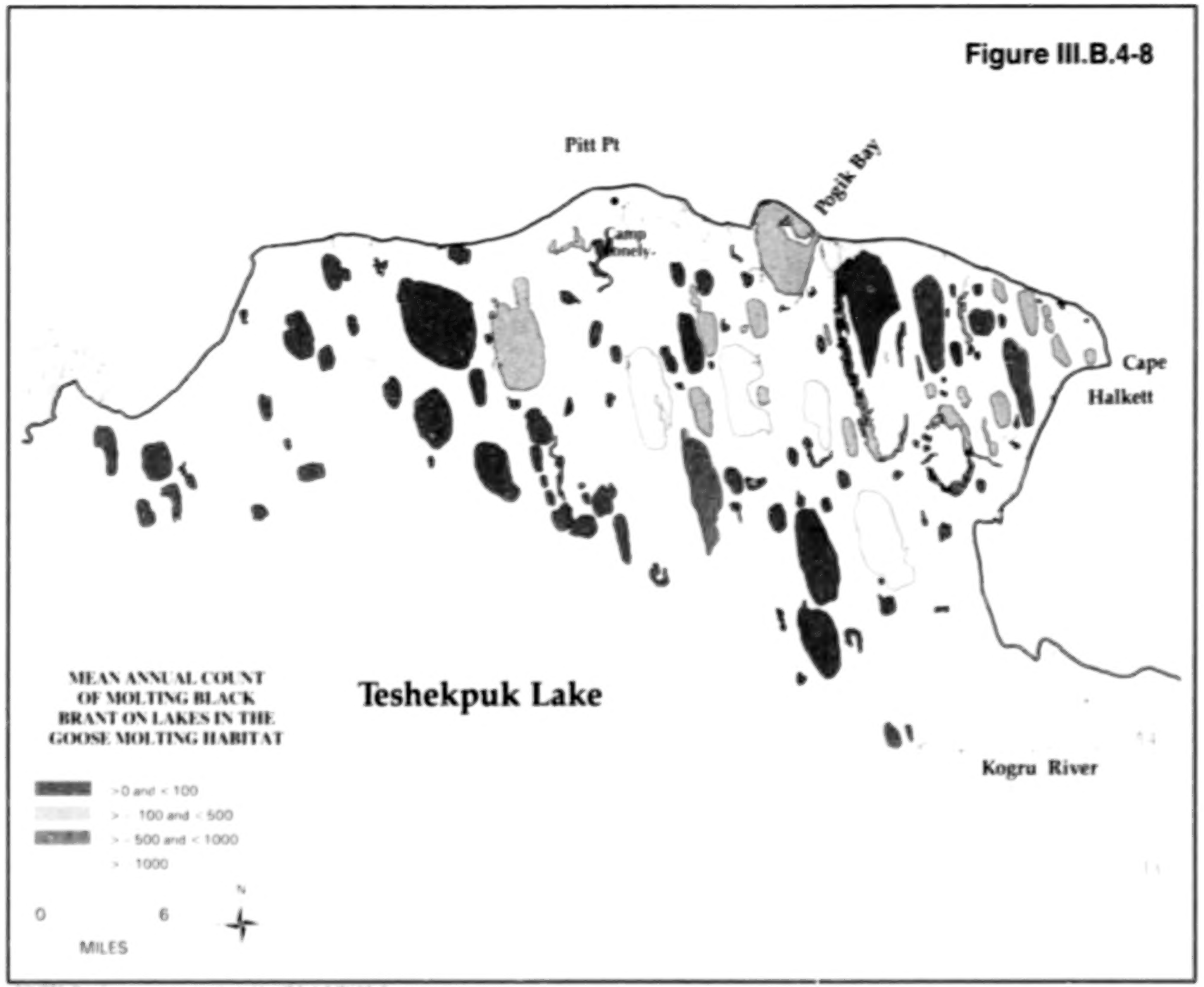


Figure III.B.4-8

SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

BLANK PAGE

May to early June and begin the nesting cycle in early June (Table III.B.4-3). Brant breed in traditional colonies (>2 nests) located primarily within 5 km of the coast but also as much as 30 to 40 km inland. Nests and/or adults were counted at 29 colonies in the planning area from 1994 to 1996; 271 nests were located during 1996 surveys with a majority (173), as well as most larger colonies (10-50 nests), located between the Fish Creek and Kogru River mouths (Ritchie and Rose, 1996). Derksen, Rothe, and Eldridge (1981) found brant using deep-*Arctophila* lakes on the NPR-A for nesting. Stickney and Ritchie (1996) found moist sedge-grass meadow tundra in drained lake basins to be the preferred nesting habitat on the central coastal plain; brackish water habitats, saltmarsh, and aquatic grass marsh (*Arctophila* wetland) were favored on the Colville delta (Johnson et al., 1997). Brood-rearing brant use larger lakes without emergent vegetation and coastal fringe areas, particularly tidal slough and tideflat habitats. Some of the frequently used brood-rearing areas are indicated by mean numbers of young counted during aerial molting-goose surveys (Fig. III.B.4-7); these data are dominated by black brant and white-fronted geese. Because many lakes were not surveyed during the prime brood-rearing period, some important areas may not be indicated. Brood-rearing surveys during 1995 and 1996 recorded 1,639 and 599 adults and 566 and 368 goslings, respectively, between Pitt Point and Fish Creek (Ritchie and Rose, 1996:App. 2). Adults with young remain in these areas until early September (Table III.B.4-3).

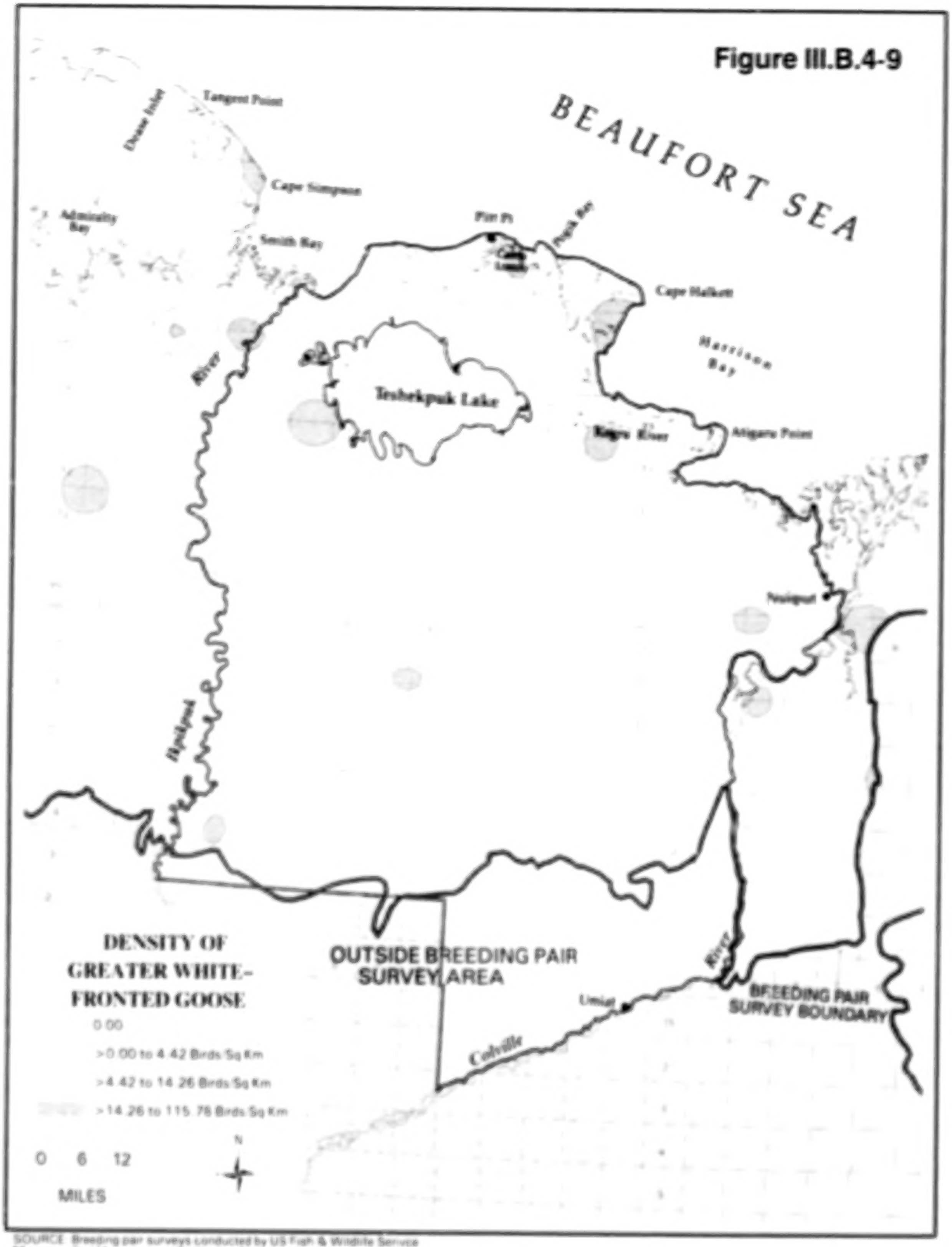
Primarily failed breeders and some nonbreeders that have migrated from breeding colonies in western Alaska, Canada, and Siberia arrive in the planning area in late June and early July to undergo molt. The international origin of this molt-migrant population from such distant nesting areas emphasizes the importance of the TLSA (Fig. I.5). The largest known concentration of molting brant occurs in the Goose Molting Habitat LUEA, which occupies much of the TLSA (Fig. I.5). Numbers counted at 200 lakes in this area from 1982 to 1996 during the molt period ranged from about 8,000 to 23,500 individuals ($\bar{x}$ = 17,500), representing up to 22 percent of the entire population (King, 1997a; King and Brackney, 1996). Sixty-one percent of adult females examined by Bollinger and Derksen (1996) on nine lakes in the TLSA from 1987 to 1992 were failed breeders. Molt lasts about 3 weeks, with most individuals initiating July 4 to 10, although some may begin as late as 25 July. Numbers of birds in molt peaks about the third week in July and few molting (flightless) birds are present after the first week in August (Derksen, Rothe, and Eldridge, 1981; Taylor, 1995). Thus, flightless brant may be present in this area from late June to mid-August (Rexstad, Sedinger, and Taylor, 1997, pers. comm.). Molting brant are associated primarily with deep-open thaw lakes north and east of Teshekpuk Lake between the Kogru River and Smith Bay (Fig. III.B.4-8). Distribution of brant within the goose-molting area is somewhat clumped with 83 percent of the birds using the 30 highest use lakes and the largest numbers occurring on nine lakes between Teshekpuk and Cape Halkett (Fig. III.B.4-8). Counts of several thousand have been recorded on the most heavily used lake, and 46 percent of the average on all lakes were brant (Table III.B.4-2). Individual brant exhibit a marked tendency to return to the same lake in successive years (Bollinger and Derksen, 1996).

Fall-staging flocks of brant concentrate in coastal habitats including Beaufort Sea lagoons, bays, and deltas (Derksen, Eldridge, and Weller, 1982).

(4) Greater White-fronted Goose: Recent aerial surveys on the coastal plain (1992-1996) indicate about 21 percent of the coastal plain population occupies the planning area (Table III.B.4-1; King, 1997, pers. comm.). High concentrations are found near southwest Teshekpuk Lake, west of the lake, east near the Kogru River, and south of Cape Halkett (Fig. III.B.4-9; includes molting individuals). Arrival on nesting areas occurs from the second or third week in May to early June (Johnson and Herter, 1989), and clutches are initiated in late May (Table III.B.4-3). Adults are accompanied by the previous year's young, which remain with the family group until incubation (Ely and Dzubin, 1994). Whitefronts generally nest farther inland than brant. Preferred nesting habitat includes elevated sites near shallow *Carex* and *Arctophila* wetlands, and beaded streams are a favored habitat for both pairs and pairs with broods (Derksen, Rothe, and Eldridge, 1981; Johnson et al., 1996). Following hatch, young whitefronts are cared for primarily by the male for about 6 weeks, usually fledging by late August (Table III.B.4-3). Although some (22%) of the same lakes used by brant are occupied during broodrearing, whitefront broods generally are more widespread (Fig. III.B.4-7).

Nonbreeding subadults make a molt migration (Barry, 1967; King and Hodges, 1979) from family groups in nesting areas to lakes in the Goose Molting Habitat LUEA, especially northeast of Teshekpuk Lake (Fig. III.B.4-10). Molting whitefronts, including nonbreeders, successful breeders and their goslings, and failed breeders, appear to be most concentrated on lakes that are located somewhat more inland near Teshekpuk Lake than the other species (Fig. III.B.4-10). Numbers of whitefronts molting in this area have ranged from about 1,000 to almost 28,000 between 1982 to 1996, in flocks of up to 600 (Derksen, Rothe, and Eldridge, 1981), with maximum counts of up to 4,020 on the most heavily used lake (Table III.B.4-2). Whitefronts have been recorded on about 145 of these lakes. Postbreeding birds favored deep open lakes during the molt; unlike brant and Canada geese, most do not shift

Figure III.B.4-9

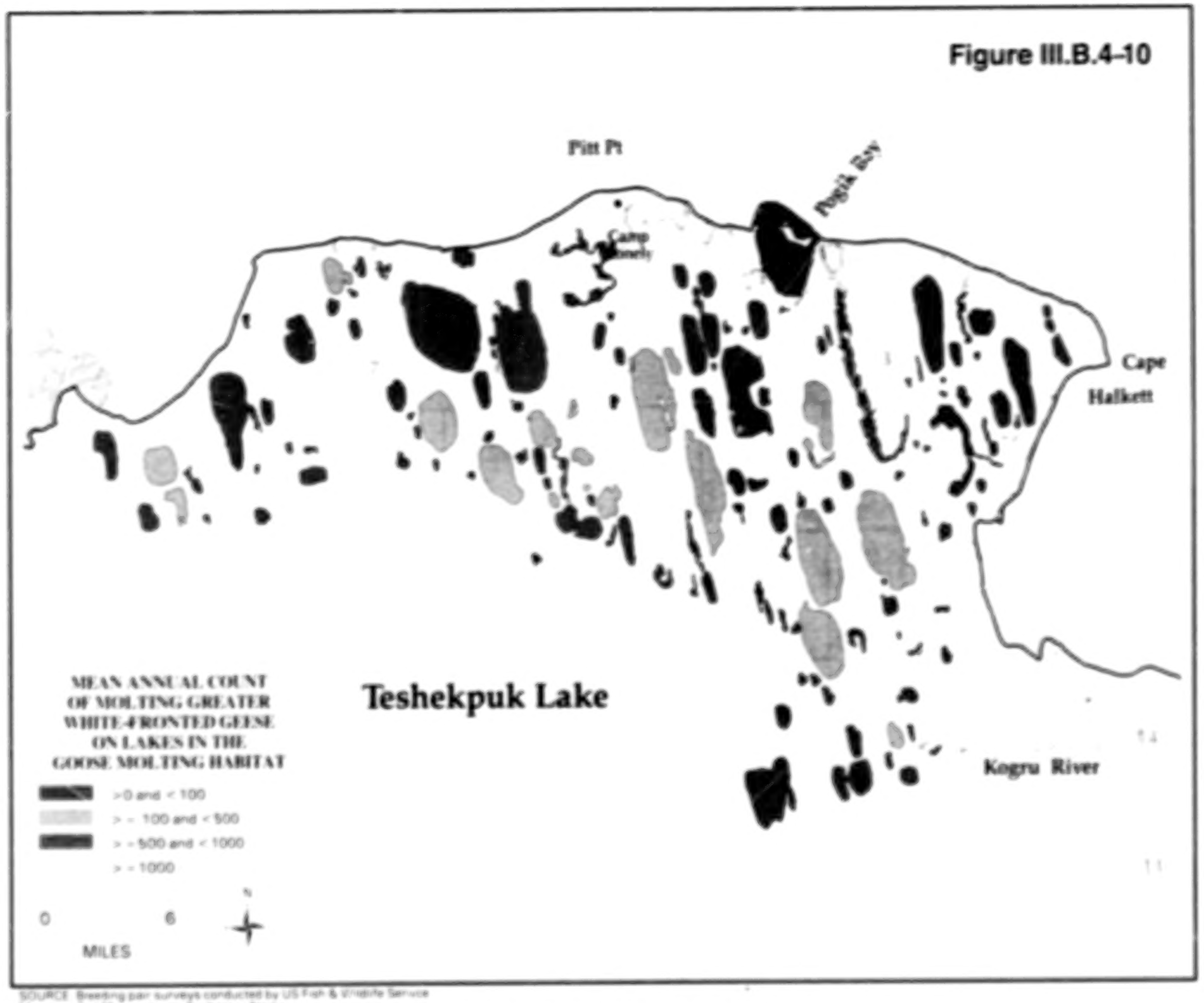


SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

BLANK PAGE

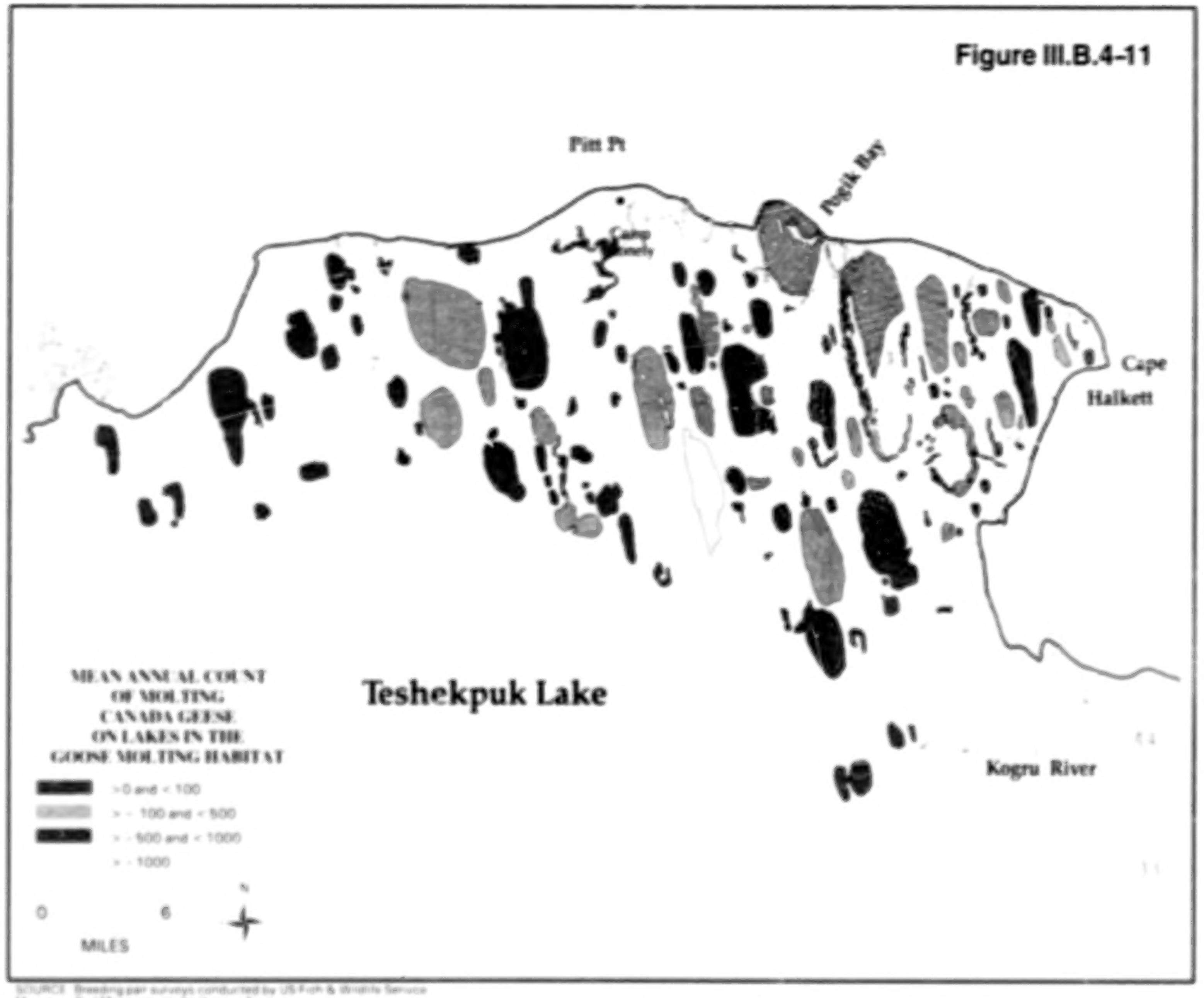
Figure III.B.4-10



SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

Figure III.B.4-11



SOURCE Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management Fairbanks Alaska

BEST COPY AVAILABLE

BLANK PAGE

to coastal areas following wing molt (Derksen, Rothe, and Eldridge, 1981).

(5) Other Geese: Several hundred Canada geese were found nesting along banks and bluffs of the Colville River above Umiat by Kessel and Cade (1958), and more recently they have been found nesting on bluffs along the Colville (Swem, 1997, pers. comm.). Molt migration of nonbreeding and probably failed breeding geese to this area occurs as early as June 9 (Renken, North, and Simpson, 1983), peaking in mid-July (Derksen, Rothe, and Eldridge, 1981). A majority of Canada geese molt on larger deep lakes from Teshekpuk northeast to Cape Halkett (Fig. III.B.4-11); up to 2,935 have been recorded on the most heavily used lake (Table III.B.4-2). following the flightless period in late July-early August, most move from lakes to coastal wetlands (Derksen, Weller and Eldridge, 1979). The Colville delta adjoining the planning area is an important staging area for Canada geese migrating along the Beaufort Sea coast from the east (Garner and Reynolds, 1986; Johnson and Richardson, 1981); as many as 11,000 birds may be present, with arrival beginning in mid-August (Johnson et al., 1996). A small nesting colony of lesser snow geese with 40 to 60 pairs (200 birds and 60 pairs in 1992) occurs adjacent to the planning area on the Ikpikpuk River delta (Johnson et al., 1996; Ritchie and Burgess, 1992). Fewer than 500 molt migrant snow geese have been observed in the Teshekpuk Lake area (Table III.B.4-2).

(6) Ducks: Of 15 duck species that may be expected to occur on the NPR-A, average numbers of 9 species exceed 3,500 in the breeding-pair-survey area, and 5 species exceed 10,000 (Table III.B.4-1). Distribution of some species across the coastal plain is relatively uniform, as indicated by the proportion of the coastal plain population occurring in the planning area (pintail, 23%; oldsquaw, 33%; king eider, 19%; scaup, 27%; but scoter, 10%) as compared to the proportion of the entire coastal plain survey area represented by the planning area (24%) (King, 1997, pers. comm.). Abundance of the northern pintail and oldsquaw on the coastal plain is substantially greater than other species, representing about 83 percent of individuals observed on aerial surveys.

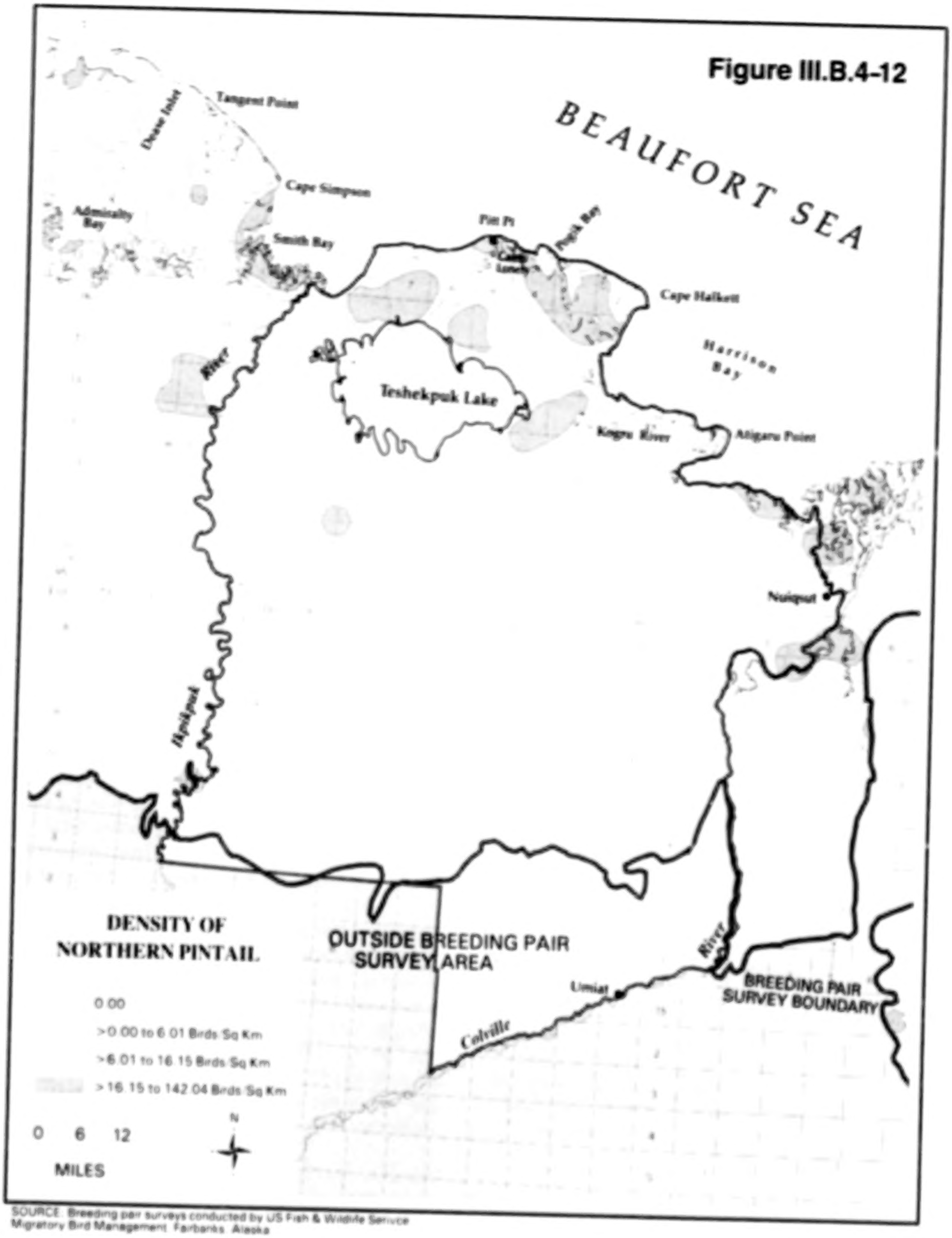
Wetland habitat use is varied among species in this group but appears strongly related to food abundance associated with emergent vegetation in aquatic habitats (Derksen, Rothe, and Eldridge, 1981; Gilliam and Lent, 1982). The most preferred habitat types include shallow-*Carex* and *Arctophila* wetlands, deep-*Arctophila* lakes, beaded streams, and deep-open lakes.

Highest pintail concentrations recorded on aerial surveys of the planning area are north and east of Teshekpuk Lake, the Pitt Point-Cape Halkett area, the Fish Creek delta area, and along the Colville River south of Nuiqsut (Fig. III.B.4-12). The seasonal population typically is much larger than indicated by the number of nests observed during surveys (Martin, 1997, pers. comm.), suggesting a large nonbreeder/failed breeder component. Probably as a result of displacement of individuals from southern nesting areas during drought, numbers may vary as much as 62 percent between years (Derksen and Eldridge, 1980). Average density in the planning area in 1992 to 1996 (Table III.B.4-1) is at the low end of the range of 2.3 to 17.1 observed by Derksen, Rothe, and Eldridge (1981) near Teshekpuk Lake. Pintails arrive in late May and remain through mid-September (Table III.B.4-3). Males abandon the females early in the incubation period, forming flocks, possibly with nonbreeding and failed breeding individuals, which begin departing the Beaufort Sea area in early July. Nesting pintails prefer shallow ponds with *Arctophila* or *Carex* vegetation, and beaded-stream habitat with *Arctophila* (Derksen, Rothe, and Eldridge, 1981).

Highest concentrations of the widespread oldsquaw are found well to the west of the planning area; within the area, high-density areas occur in the Pitt Point, Cape Halkett, and Atigaru Point areas, and scattered locations in the southwestern half of the planning area (Fig. III.B.4-13). Spring migrant oldsquaw follow leads along the Beaufort coast, arriving in the Colville delta area in late May (Renken, North, and Simpson, 1983). Inland routes also are used. At this time, oldsquaw congregate on open water of large lakes and use deep-*Arctophila* wetlands as available. Egg laying is not initiated until late June (Table III.B.4-3). Breeding-season density in the planning area is substantially lower (Table III.B.4-1) than reported by Derksen, Rothe, and Eldridge (1981) as 3.3 birds/km^2 near the coast and 4.6/km^2 at inland sites. Oldsquaw disperse to shallow-*Carex* and *Arctophila* ponds, and deep-*Arctophila* ponds for nesting. They frequently nest in clusters or colonies (Alison, 1975). Males leave the nesting area during hatch and, together with nonbreeders/failed breeders, move to large coastal plain lakes and nearshore Beaufort Sea waters to molt (Derksen, Rothe, and Eldridge, 1981; Garner and Reynolds, 1986), often forming massive flocks (e.g., 566 birds/km^2 at Simpson Lagoon; estimated 50,000 individuals). Females lead the young to deep-*Arctophila*, deep-open, or shallow-*Carex* lakes with open water shortly after hatch, and molt on deep-open lakes when the young are almost ready to fly (Derksen, Rothe, and Eldridge, 1981; Johnson, 1984; Johnson and Richardson, 1981). Following molt they move to coastal lagoons for staging until migration begins in late September (Table III.B.4-3).

Aerial survey counts of king eiders during the breeding season have exhibited an upward trend on the coastal plain from 1992 to 1996 (Larned and Balogh, 1997), although prebreeding counts at Point Barrow suggest a decline of eiders using the Beaufort Sea (Suydam et al., 1997). They

Figure III.B.4-12



SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

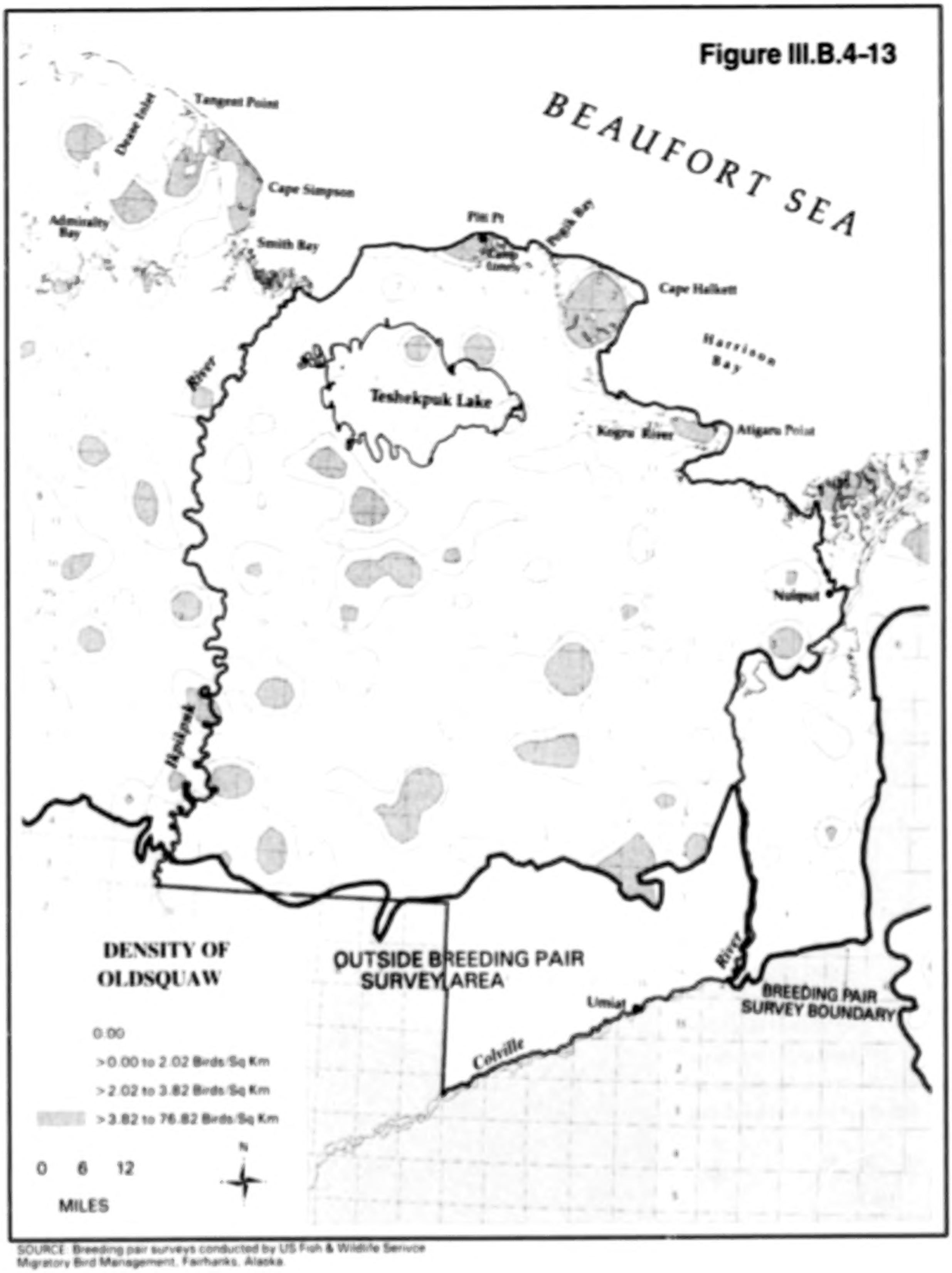
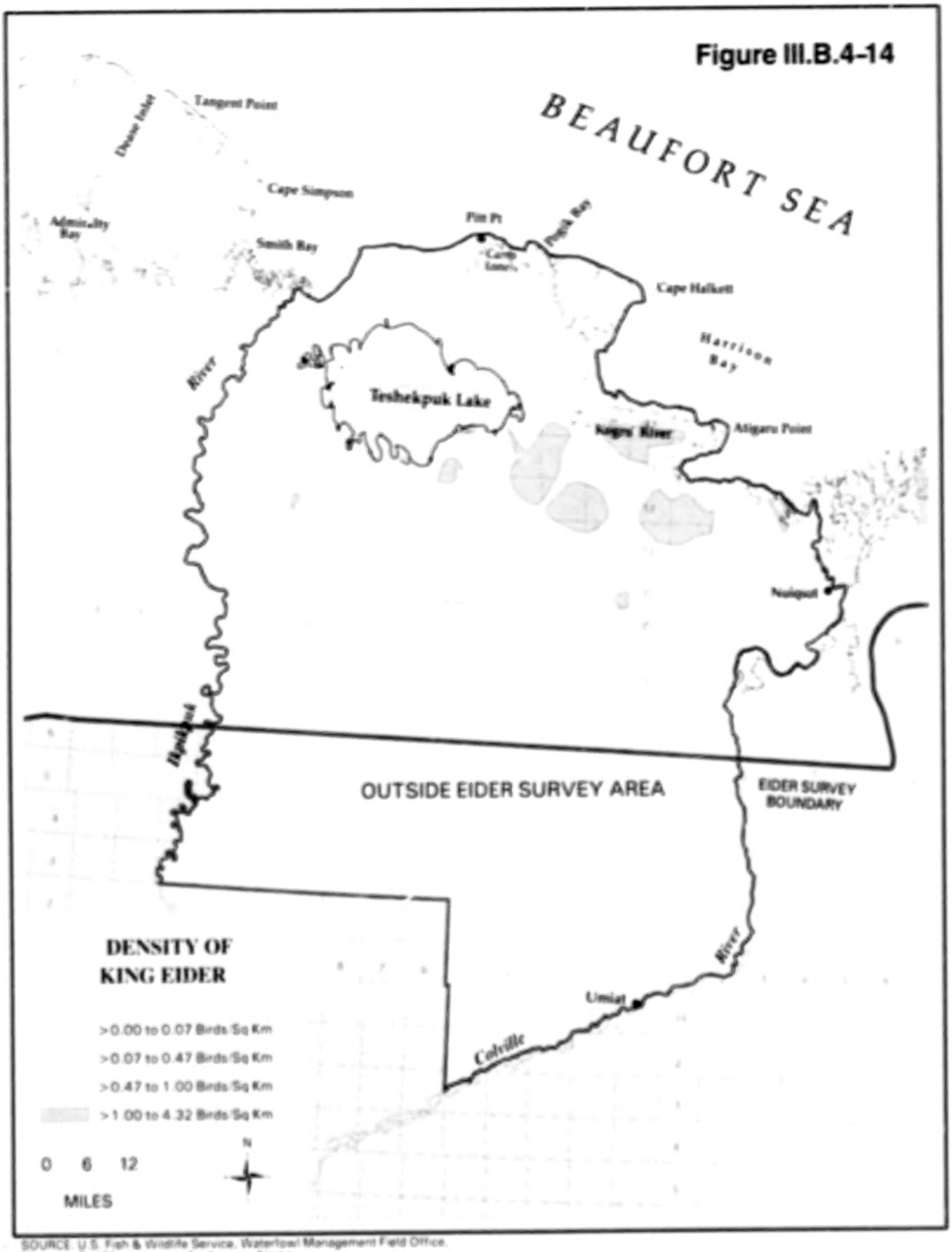


Figure III.B.4-13

SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska.

BEST COPY AVAILABLE

Figure III.B.4-14



SOURCE: U.S. Fish & Wildlife Service, Waterfowl Management Field Office, Migratory Bird Management, Anchorage, Alaska

BEST COPY AVAILABLE

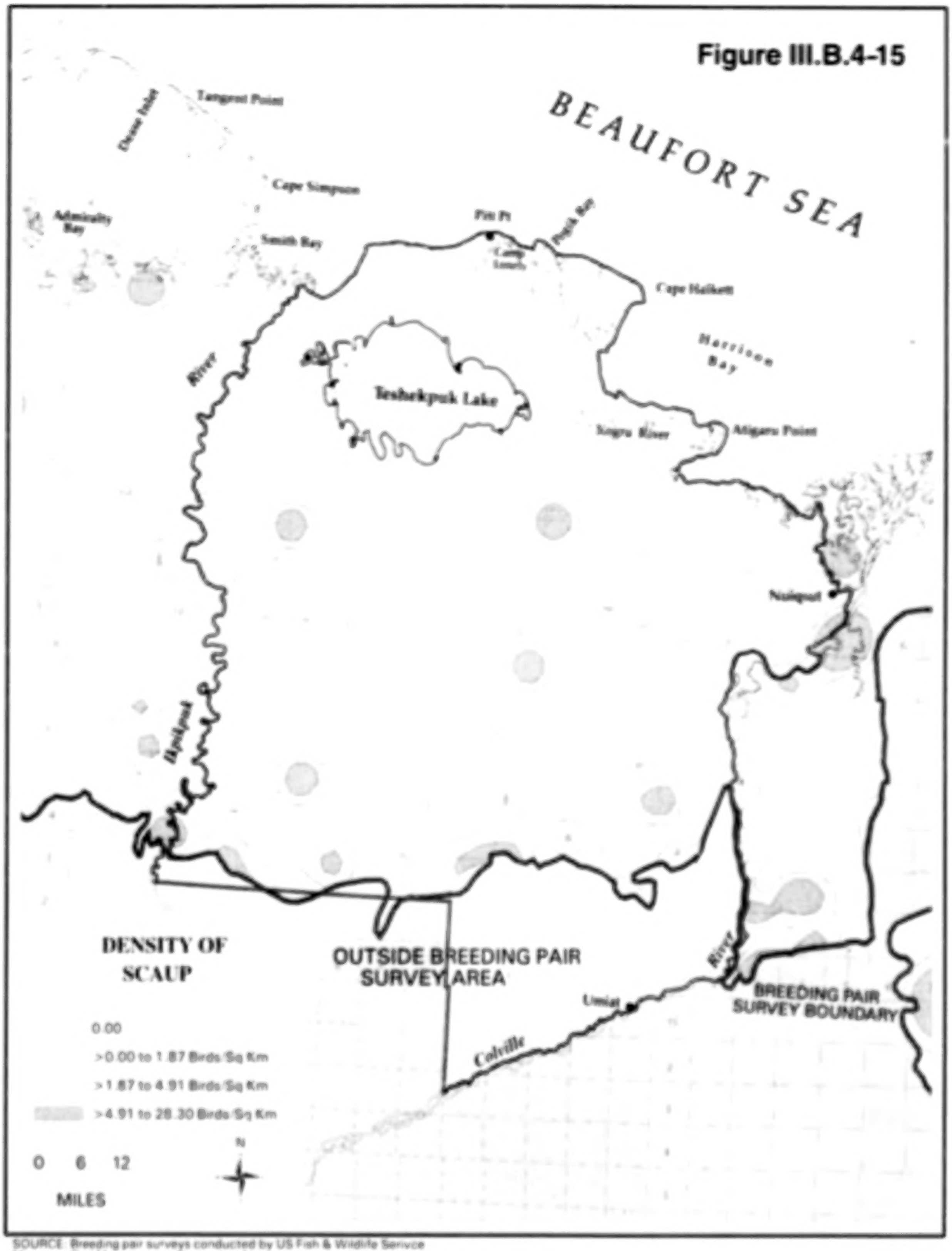


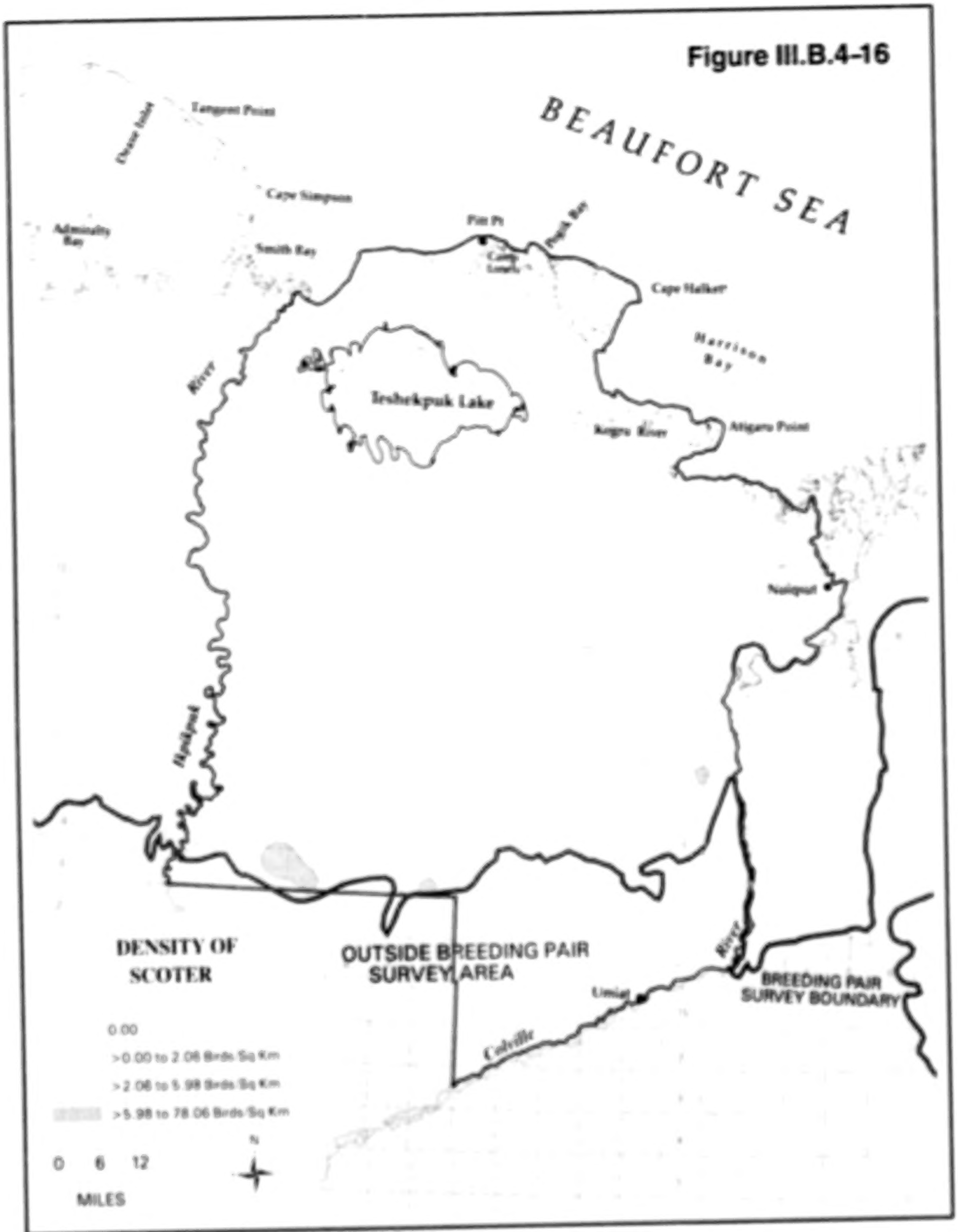
Figure III.B.4-15

SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska.

BEST COPY AVAILABLE

167

Figure III.B.4-16



SOURCE Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

168

are relatively more numerous in the planning area, compared to the coastal plain, than are other species of ducks (Table III.B.4-1). High density areas occur over a broad area southeast of Teshekpuk Lake (Fig. III.B.4-14). King eiders arrive on the delta in late May (Table III.B.4-1). Although Derksen, Rothe, and Eldridge (1981) found no evidence of breeding, their sites lie outside the indicated higher density areas; it is likely that considerable numbers nest in the planning area given the substantial area of higher density. King eider nests typically are located some distance from the coastal fringe. Derksen, Rothe, and Eldridge (1981) reported that the preferred habitat at Storkersen Point during nesting in June was shallow-*Arctophila* wetland, with deep-*Arctophila* chosen half as often. Brood rearing takes place primarily in the latter habitat with some use of deep, open lakes and beaded streams.

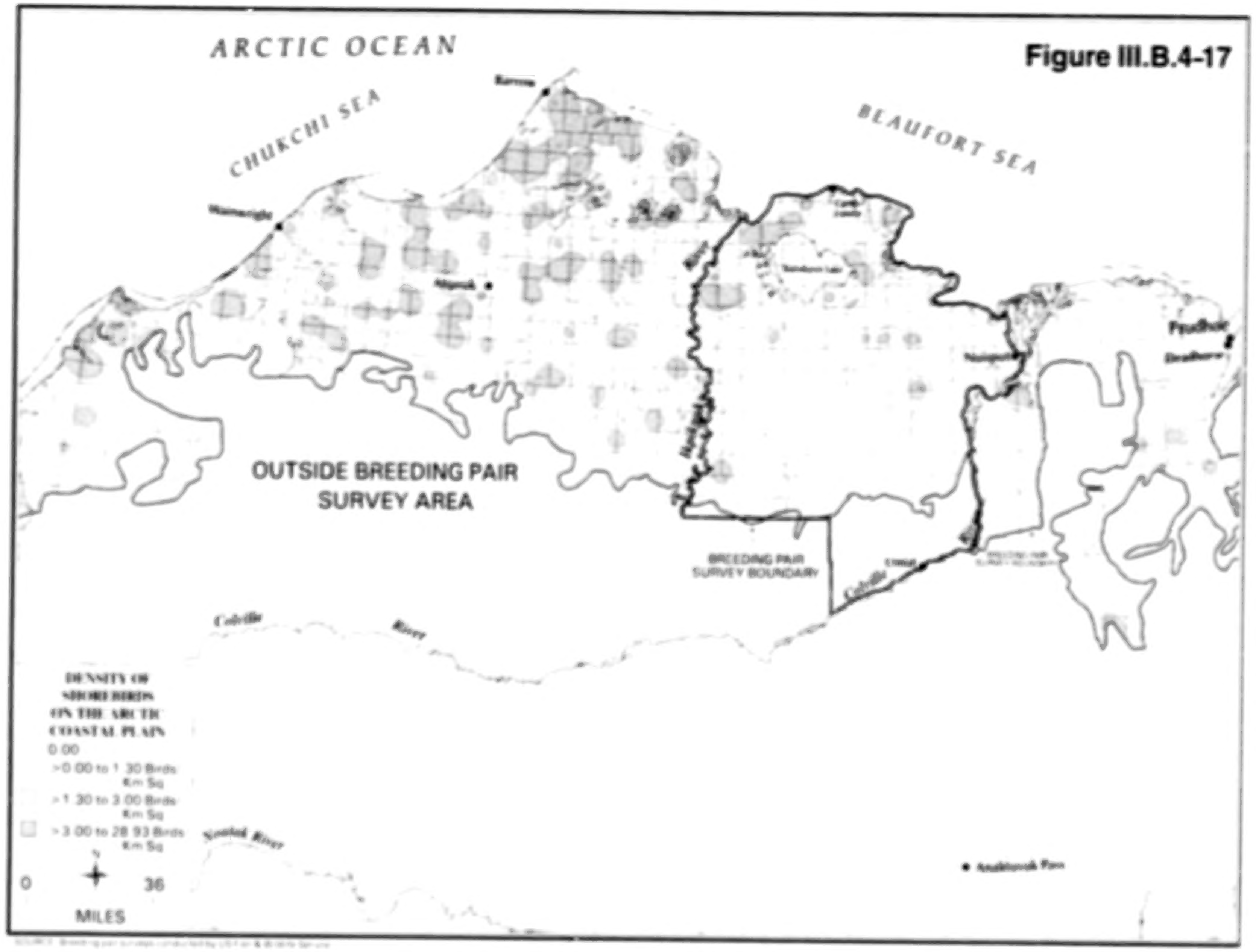
Common eiders nest in loose aggregations or small colonies along the coast and on barrier islands of the Beaufort Sea. For example, on Thetis and Spy Islands in eastern Harrison Bay, 82 and 26 nests, respectively, were recorded in 1985; on these and other examined islands the numbers of common eiders breeding has increased since 1970 (Johnson, Herter, and Bradstreet, 1987). During arctic coastal plain eider surveys, numbers of common eiders ranged from 190 to 1,390 (Balogh and Larned, 1995). Arrival in the area is in late May/early June, and nesting is initiated in mid- to late June. Eiders select nest sites on sand and gravel islands where driftwood and Elymus grass is most dense (Johnson, Heerter and Bradstreet, 1987). Broodrearing takes place in lakes or nearshore coastal habitats. A westward molt-migration of males takes place in late June and early July; a majority of these birds migrate within 50 km of the coast (Bartels, 1973). Females and young from across the Arctic migrate westward through the Beaufort Sea in late August and early September.

Areas of higher density scaup concentration are scattered on the coastal plain; however, approximately half of such areas lie within the planning area (Fig. III.B.4-15). Primarily these are inland areas, although two substantial concentrations are located on or near the Colville delta in the vicinity of Nuiqsut. Density of scaup in the planning area from 1992 to 1996 surveys was 0.6 birds/km^2 (King, 1997a, pers. comm.). Scaup arrive in the area in late May/early June. Nesting is initiated from early to mid-June; males leave the nesting area to molt about mid-July (Derksen, Rothe, and Eldridge, 1981). Scaup preferred deep-*Arctophila* lakes for nesting, molting, and broodrearing. Scoters, primarily white-winged scoters, are not particularly common in the planning area, being extremely scattered and mainly inland in distribution. Only one substantial concentration area located near the southwestern boundary of the area was observed during aerial surveys (Fig. III.B.4-16; King, 1997a, pers. comm.).

b. Shorebirds: Although high-density areas appear more numerous west of the planning area when surveyed in late June/early July (Fig. III.B.4-17), shorebirds are expected to be numerically dominant in planning area bird communities, as is true of most coastal plain areas. Estimated numbers of all species in the planning area may range from 0.3 to 2.8 million (based on densities in ARCO, 1996:Appendix I-2; Andres, 1994; Garner and Reynolds, 1986). Densities of these species vary considerably between sites and years, ranging from 20 to 185 birds/km^2. Based on observations in the planning area on the Colville River delta, and near Barrow, 12 shorebird species could be expected to breed regularly in the planning area, 5 with substantial abundance; 6 other species are probable breeders (Table III.B.4-4).

Most species arrive at nesting areas in late May and early June, with nesting taking place in June and July. Although nearly all shorebirds use tundra habitats for nesting, species composition of nesting communities varies between inland and coastal areas; for example, numbers of dunlin and red phalarope decrease from coastal to inland areas, whereas stilt sandpiper and long-billed dowitcher numbers are higher at interior sites (Derksen, Rothe, and Eldridge, 1981). Seasonal habitat use within the group also is variable, but there is a general postbreeding movement from tundra habitats occupied for nesting to marine littoral zone, saltmarsh, and barrier-island habitats for staging in late summer and migration into early September by many species (Andres, 1994; Connors, Connors, and Smith, 1981; Rothe et al., 1983; Smith and Connors, 1993). For some, this may result in rapid postbreeding increases of individuals, such as the buildup of migrating adult semipalmated sandpipers in late July, followed by a sharp peak of migrating juveniles in early August (Connors, Myers, and Pitelka, 1979). These authors identified several habitat use patterns, including (1) use of tundra habitats for both breeding and postbreeding (adults and juveniles) activities by golden plover and pectoral sandpiper; (2) those breeding on tundra but using both habitat types during the postbreeding period (both adults and juveniles), such as dunlin and long-billed dowitcher; (3) those that use both habitat types during breeding (nesting on tundra and foraging in littoral habitats) and postbreeding periods, such as semipalmated and Baird's sandpipers; and (4) those with pronounced age-sex differences in timing and habitat use, such as red phalarope. After egg laying, females flock on tundra ponds in late June/early July and have migrated by mid- to late July. Males attend the young until early August, when they flock and depart by mid-August or shortly after, occupying littoral habitats to a variable extent; at this time, juveniles move to littoral habitats in large numbers until early September when they migrate. Also in

Figure III.B.4-17


ARCTIC OCEAN
CHUKCHI SEA
BEAUFORT SEA
Barrow
Wainwright
Atqasuk
Teshekpuk Lake
Nuiqsut
Prudhoe
Deadhorse
OUTSIDE BREEDING PAIR SURVEY AREA
BREEDING PAIR SURVEY BOUNDARY
Umiat
Colville
Colville River
Noatak River
Anaktuvuk Pass
DENSITY OF SHOREBIRDS ON THE ARCTIC COASTAL PLAIN
0.00
>0.00 to 1.30 Birds Km Sq
>1.30 to 3.00 Birds Km Sq
>3.00 to 28.93 Birds Km Sq
N
0
36
MILES

SOURCE: Breeding pair surveys conducted by U.S. Fish & Wildlife Service

BEST COPY AVAILABLE

170

BLANK PAGE

this category, ruddy turnstones are found almost entirely in littoral habitats after nesting. Thus, for all species in this study, tundra habitats were occupied in substantial numbers from early June until early September; but by early August a marked movement from tundra to marine littoral habitats that lasts until early/mid September is under way.

Andres (1994), comparing relative use of Colville delta shoreline silt barren and saltmarsh habitats by postbreeding shorebirds, found 16 of 18 species more common in saltmarsh habitat, although silt barrens received disproportionately high use by dunlins and sanderlings.

(1) Plovers: Plovers nest on drier upland sites than most other shorebirds (Johnson and Herter, 1989). Densities in the planning area typically do not exceed 5.0 birds/km^2 (Derksen, Rothe, and Eldridge, 1981). Eggs are laid through mid-June and hatch late June to mid-July (Parmalee et al., 1967). Young are led to moist or wet tundra habitats soon after hatching (Johnson and Connors, 1996). Adults leave the young and gather into flocks prior to fall migration; most have departed by mid-August. The postfledging young gather into flocks and remain until late August or early September.

(2) Sandpipers: Of the remaining species, densities of the most common breeders observed by Derksen, Rothe, and Eldridge (1981) at three sites in the planning area were the semipalmated sandpiper (1.4-15.5 birds/km^2), pectoral sandpiper (11.6-36.3), red-necked phalarope (1.0-16.8), dunlin (0.2-16.0), and red phalarope (0.3-32.5). Although most species have been recorded nesting in habitats ranging from dry to wet tundra, those such as the semipalmated sandpiper appear to prefer moist or wet tundra-foraging habitat adjacent to a nest site on well-drained ridges (Troy, 1988). Shorelines of shallow-*Carex* ponds were important feeding areas for semipalmated sandpipers at NPR-A sites in late June to early July (Derksen, Rothe, and Eldridge, 1981). Egg laying begins in early June, with peak hatching typically in mid-July (Table III.B.4-2) (Norton, 1973; Gratto and Cooke, 1987; Gratto-Trevor, 1992). Females desert the brood within 2 weeks and males about a week later (Gratto-Trevor, 1991). Adults initiate southward migration in mid-July with maximum departure in late July to mid-August (Gratto-Trevor, 1992). Juveniles gather in large flocks on inland wetland areas and along marine beaches and saltmarshes prior to peak departure in August (Connors, Myers, and Pitelka, 1979).

Phalaropes prefer wet, marshy areas for nesting, with access to open water, where they typically forage. Egg laying occurs from the second week of June to early July. Adults stage in large groups on NPR-A lagoons from mid-July to early September (Gilliam and Lent, 1982). Red phalarope females form feeding flocks on tundra ponds, departing the breeding area in mid- to late July (Connors, Myers, and Pitelka, 1979). Males form flocks and depart the nesting area when the young fledge in early to mid-August.

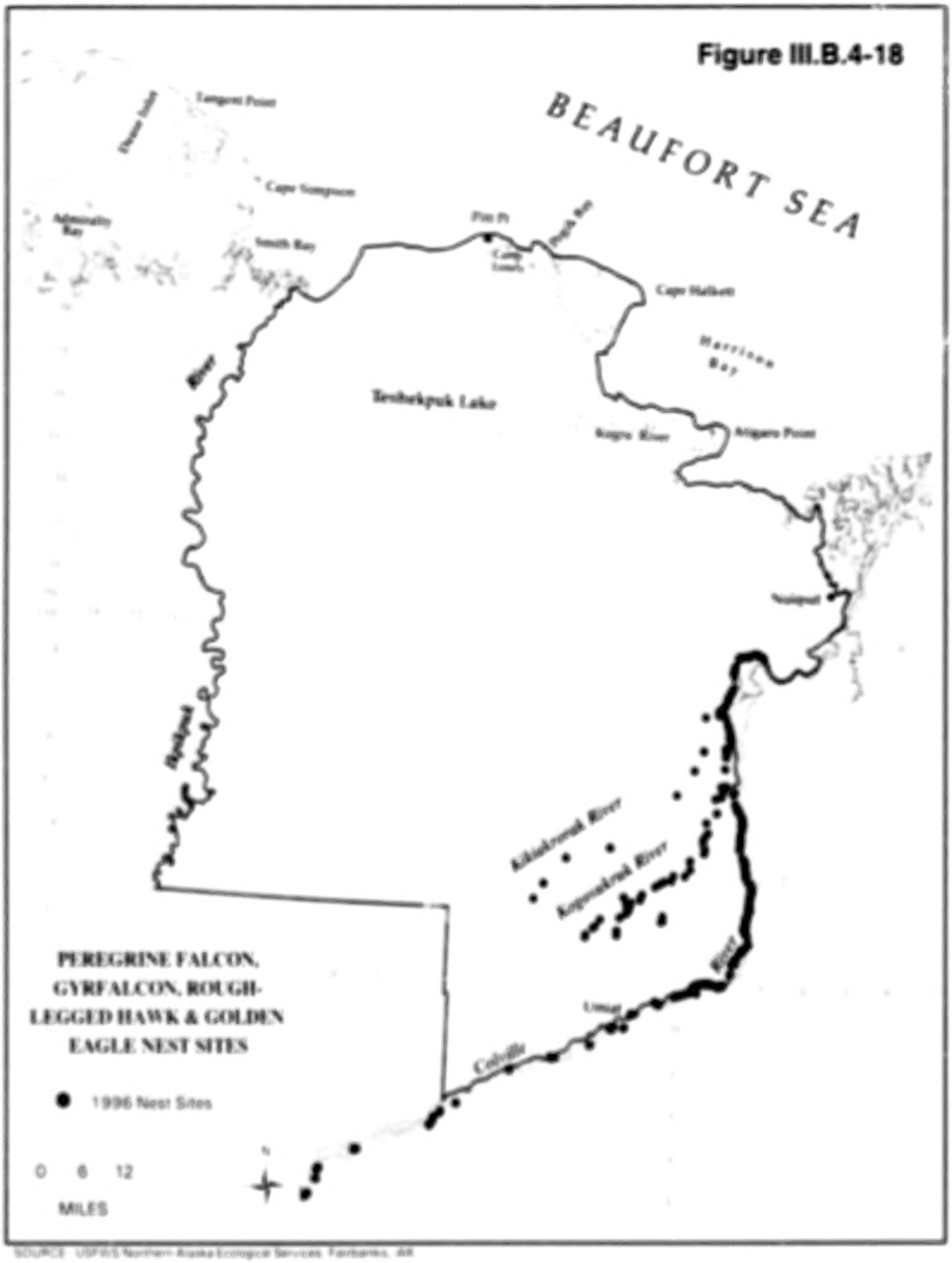
c. Passerines: Of the 10 to 12 species that may be expected to occur regularly in the planning area six—including Lapland longspur, savannah sparrow, redpoll, snow bunting, yellow wagtail, and American tree sparrow—may be fairly common to abundant breeders. Abundance of the Lapland longspur is greater than that of all other species combined (Derksen, Rothe, and Eldridge, 1981). The common raven, though not abundant, is the only resident species in this group; all others are migrants. Species richness of passerines is highest in riverine and low and tall upland shrub habitats. Tall shrub habitat in particular is important for nesting, foraging, and escape from predators for most species occurring in the area.

The Lapland longspur is widespread and often the most abundant species in many coastal plain areas (Johnson and Herter, 1989). Derksen, Rothe, and Eldridge (1981) reported longspur- breeding densities ranging from 24.3/km^2 to 64.2/km^2 at study sites in the planning area. Longspurs typically arrive on the Colville delta in mid-May (North, Schwerin, and Hiemenz, 1984). Nesting is initiated in early June, with the nest constructed on tussock-heath tundra or polygon ridge. Hatching occurs in mid- to late June. Flocks of postbreeding longspurs begin forming in late July and gradually depart from the Beaufort Sea area by the end of August or early September (Martin and Moitoret, 1981).

d. Raptors: In the NPR-A, cliff-nesting raptors tend to be more common inland than near the coast. The peregrine falcon, gyrfalcon, and rough-legged hawk are regular breeders on cliffs along rivers in the planning area. Merlins nest in low numbers along larger rivers in the southern planning area. The golden eagle occurs regularly in the planning area. The snowy owl, short-eared owl, and northern harrier are widely dispersed and nest irregularly in the planning area; snowy owls are more common near the coast.

(1) Arctic Peregrine Falcon: The arctic peregrine falcon, although no longer a listed species, will be monitored by FWS until 1999. The arctic peregrine population is estimated to be a few thousand pairs, probably increasing, with 250 pairs in Alaska (Swem, 1997). About half of the Alaskan population nests in the NPR-A, with an estimated 60 to 65 pairs nesting along the Colville River (Swem, 1997), a major nesting corridor (Fig. III.B.4-18). Nests are recorded as far north as Ocean Point on the Colville River near Nuiqsut (Swem, 1995, pers. comm., as cited in ARCO, 1996). Currently used or historical nest sites are located on the Ikpikpuk and

Figure III.B.4-18



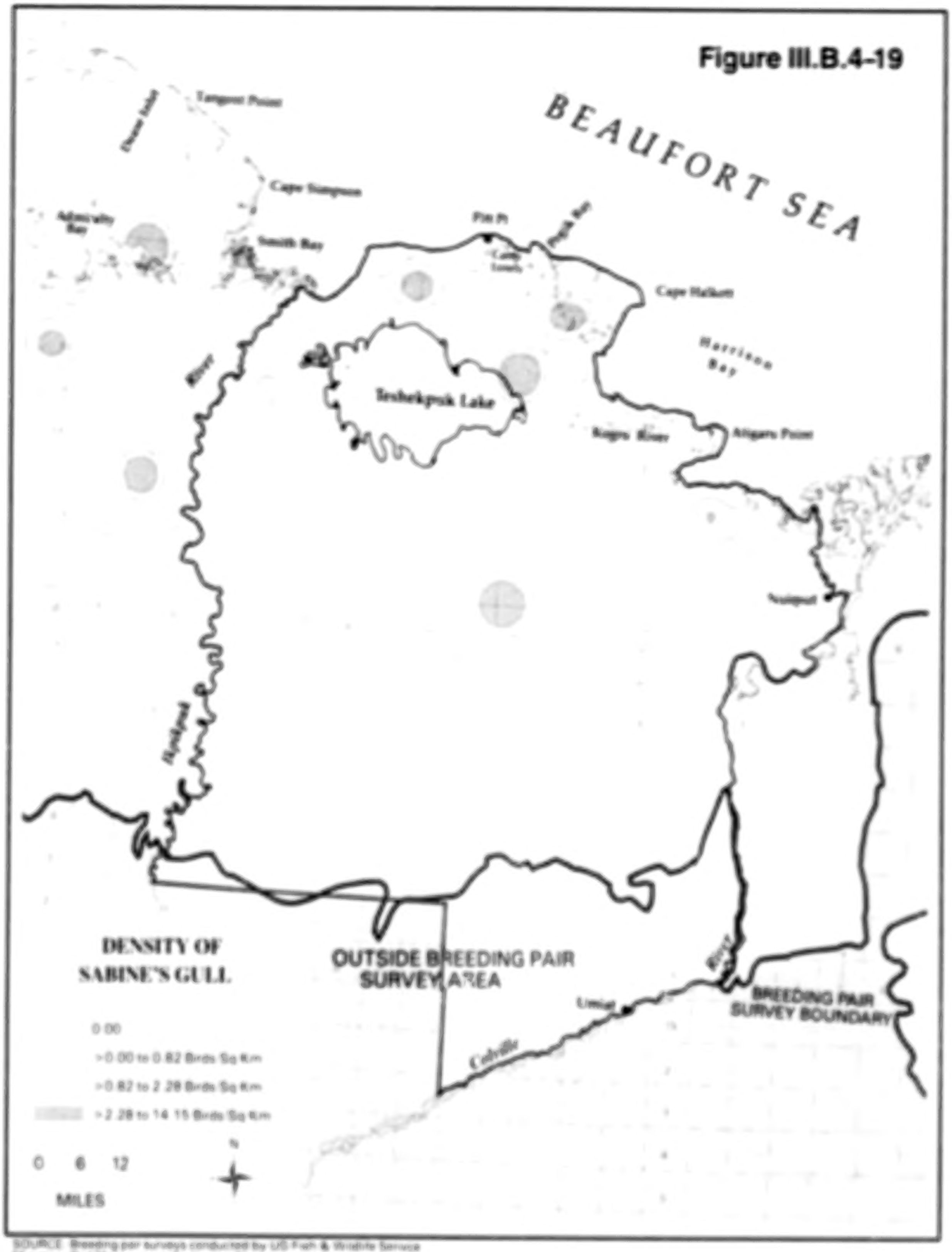
PEREGRINE FALCON, GYRFALCON, ROUGH-LEGGED HAWK & GOLDEN EAGLE NEST SITES

SOURCE USFWS Northern Alaska Ecological Services, Fairbanks, AK

BEST COPY AVAILABLE

172

Figure III.B.4-19



SOURCE: Breeding pair surveys conducted by US Fish & Wildlife Service Migratory Bird Management, Fairbanks, Alaska

BEST COPY AVAILABLE

Kogosukruk rivers in the planning area (USDOI, 1978; Swem, 1996), and surveys in 1997 located 21 pairs on the latter and 8 pairs on the Kikiakrorak River (Swem, 1997, pers. comm.). There are no known active nest sites along the coast in this area. Arctic peregrine falcons are present in Alaska from about mid-April to mid-September. Nesting is initiated in mid-May on the Arctic Slope, and the young fledge from about the end of July to mid-August (USDOI, FWS, 1982). Immature peregrines are known to use coastal habitats east of the Colville River in late August through mid-September (Johnson and Herter, 1989).

(2) Gyrfalcon: The gyrfalcon is a fairly common resident of the northern foothills and mountainous areas of the Arctic Slope and relatively uncommon on the coastal plain. Ritchie (1979) estimated that 40 to 50 pairs of gyrfalcons nest in the NPR-A, although numbers fluctuate considerably among years. The only known nesting area currently in use in the planning area is the Colville River, where 10 to 30 pairs nest (Swem, 1997). Historically, nests have been reported on the Kogosukruk and upper Ikpikpuk rivers (USDOI, 1978). Gyrfalcons nest on isolated outcrops in the Brooks Range and on outcrops, cliffs, and bluffs along the Colville and other rivers. They initiate nesting in early spring, and the broodrearing period is May to mid-August (Swem, 1997). Gyrfalcons are nonmigratory if prey, primarily ptarmigan, remains abundant throughout the winter.

(3) Rough-Legged Hawk: Rough-legged hawks are most abundant and successful breeders in years when microtine rodents, their preferred prey, are abundant. Rough-legs arrive at their northern breeding grounds by early May, remaining until late September. Swem (1997) estimated between 300 and 500 pairs may nest in the NPR-A in some years, with up to 100 pairs nesting along the Colville River between the Etivluk River and Ocean Point. As many as 35 pairs may nest upriver from the Etivluk River, and 5 to 10 pairs probably nest along each of the Colville River tributaries, as recorded along the Kogosukruk River (Ritchie, 1979).

(4) Other Raptors: Golden eagles primarily are visitors to the foothills of the Brooks Range and coastal plain, breeding regularly mainly in the mountains (Johnson and Herter, 1989). They may breed occasionally in the NPR-A; one nest was found along the Colville River close to or within the planning area boundary in 1997 (Swem, 1997, pers. comm.). Nest sites previously have been reported along the Kogosukruk River (USDOI, 1978). Ground-nesting species that occur in the planning area include snowy and short-eared owls, northern harrier, and merlin (Swem, 1997). Snowy owls are a fairly common resident in the Beaufort Sea area, breeding irregularly in coastal areas east of Barrow (Johnson and Herter, 1989). The short-eared owl is an occasional breeder; like snowy owls and other raptors, they are most common in areas and years when microtine rodent numbers are high (Martin, 1997, pers. comm.). Northern harriers occasionally breed in the northern foothills of the Brooks Range. Merlins occasionally nest in the planning area (Swem, 1997, pers. comm.), and nests with young have been observed at Umiat Mountain within the planning area (Swem, White, and Ritchie, 1992).

e. Seabirds: Seabirds occurring in or adjacent to the planning area include three jaeger species, glaucous gull, Sabine's gull (Fig. III.B.4-19), arctic tern, and black guillemot.

Glaucous gulls and the parasitic jaegers are predators on eggs and young of other bird species. Jaegers nest on the tundra, generally nesting more abundantly in areas and years of microtine rodent abundance. Glaucous gulls are widespread at low density on the coastal plain, with higher densities along the coast and at colonies on barrier islands and river deltas; large concentrations of several hundred individuals often gather at landfill sites.

A black guillemot colony (25 pairs) is located in Prudhoe Bay. Guillemots forage near colonies from June to early September when the chicks fledge. They winter in Beaufort Sea leads.

f. Ptarmigan: Derksen, Rothe, and Eldridge (1981) found the willow ptarmigan to be a common breeder at Square Lake near the coastal plain southern boundary (3.8 birds/km^2) where the habitat is upland heath-tussock tundra, and uncommon nearer the Beaufort coast (0.1/km^2). Onset of breeding display is mid- to late May (Martin and Moitoret, 1981); following hatch in late June the young develop quickly, becoming independent by late August or early September (Cramp and Simmons, 1980).

5. Mammals:

a. Terrestrial Mammals: Among the terrestrial mammals that occur in the planning area, the species that could be most affected by development are the barren-ground caribou, muskoxen, moose, grizzly bear, wolf, wolverine, and arctic fox.

(1) Caribou: One large caribou herd and two smaller ones use habitats within or adjacent to the planning area—the Western Arctic, Teshekpuk Lake, and Central Arctic herds (WAH, TLH, and CAH, respectively).

(a) Population Status and Range: The WAH was estimated by Machida (1994) to number 450,000. The herd ranges over territory in northwestern Alaska from the Chukchi coast east to the Colville River, and from the Beaufort coast south to the Kobuk River. In winter the range extends as far south as the Seward Peninsula and Nulato Hills and as far east as the Sagavanirktok River north of the Brooks Range, and east to the Koyukuk River south of the Brooks Range. The TLH was estimated to be 11,800 in 1984, 16,600 in 1988, and >27,000 in 1994, yielding average annual increases of 7.1 percent during 1984 to 1988 and 14 percent during 1988 to 1994 (Carroll, 1992; Machida, 1994). The 1995 census showed a slight decline to 25,000 animals, probably due to the previous severe winter (USDOI, BLM, NPR-A Briefing Report, 1996). The TLH is found primarily within the NPR-A with its summer range extending between Barrow and the Colville River. In some years, most of the TLH remains in the Teshekpuk Lake rea all winter. In other years, some or all of the herd winters in the Brooks Range or within the WAH range. The CAH was estimated to number 23,000 in 1992, but declined to about 18,100 animals in 1994 (Abbott, 1993; Whitten, 1995, pers. comm.). Its range extends from the Itkillik River east to the Canning River, and from the Beaufort coast south into the Brooks Range.

(b) Migration: Caribou migrate seasonally between their calving areas, summer range, and winter range to take advantage of seasonally available forage resources. If movements are greatly restricted, caribou are likely to overgraze their habitat, leading to perhaps a drastic, long-term population decline. The caribou diet shifts from season to season and depends on the availability of forage. In general, the winter diet of caribou has been characterized as consisting predominantly of lichens and mosses, with a shift to vascular plants during the spring (Thompson and McCourt, 1981). However, when TLH caribou winter near Teshekpuk Lake, where relatively few lichens are present, this herd may consume more sedges and vascular plants.

(c) Calving Grounds: Calving takes place in the spring, generally from late May to late June (Hemming, 1971). Calving areas for the WAH, TLH, and CAH are shown in Figure III.B.5.a-1. The WAH calving area is inland on the NPR-A, west of the planning area. The recent TLH central calving area generally has been located on the east side of Teshekpuk Lake and near Cape Halkett, adjacent to Harrison Bay. The CAH generally calve within 30 km of the Beaufort coast, between the Itkillik and Canning rivers.

Spring migration of parturient female caribou from the overwintering areas to the calving grounds starts in late March (Hemming, 1971). Often the most direct routes are used; however, certain drainages and routes probably are used during calving migrations, because they tend to be corridors free of snow or with shallow snow (Lent, 1980). Bulls and nonparturient females generally migrate at a very leisurely pace, with some remaining on winter ranges until June. Severe weather and deep snow can delay spring migration, with some calving occurring en route. Cows calving en route usually proceed to their traditional calving grounds (Hemming, 1971).

The spring migration to traditional calving grounds consistently provides high nutritional forage to lactating females during calving and nursing periods, which is critical for the growth and survival of newborn calves. *Eriophorum*-tussock-sedge buds (tussock cotton grass) appear to be very important in the diet of lactating caribou cows during the calving season (Lent, 1966; Thompson and McCourt, 1981; Eastland, Bowyer, and Fancy, 1989), while orthophyll shrubs (especially willows) are the predominant forage during the postcalving period (Thompson and McCourt, 1981). The availability of sedges during spring, which apparently depends on temperature and snow cover, probably affects specific calving locations and calving success.

The evolutionary significance of the establishment of the calving grounds, however, may relate directly to the avoidance of predation on the caribou calves, particularly predation by wolves (Bergerud, 1974, 1987). Caribou calves are very vulnerable to wolf predation, as indicated by the documented account of surplus predation by wolves on newborn calves (Miller, Gunn, and Broughton, 1985). By migrating north of the tree line, caribou leave the range of the wolf packs that generally remain on the caribou winter range or in the mountain foothills or along the tree line during the wolf-pupping season (Heard and Williams, 1991; Bergerud, 1987). By calving on the open tundra, the cow caribou also avoid ambush by predators. The selection of snow-free patches of tundra on the calving grounds also helps to camouflage the newborn calf from other predators such as golden eagles (Bergerud, 1987). However, the sequential spring migration, first by cows and later by bulls and the rest of the herd, is believed to be a strategy for optimizing the quality of forage as it becomes available with snowmelt on the arctic tundra (Whitten and Cameron, 1980). The earlier migration of parturient cow caribou to the calving grounds also could reduce forage competition with the rest of the herd during the calving season.

(d) Summer Distribution and Insect-Relief Areas: During calving and postcalving periods, cow/calf groups are most sensitive to human disturbance. They join into increasingly larger groups, foraging primarily on the emerging buds and leaves of willow shrubs and dwarf birch (Thompson and McCourt, 1981). In the postcalving period, July through August, caribou attain their highest degree of aggregation. Members of the WAH may be found in continuous herds numbering in excess of tens of thousands of individuals, and portions of the WAH may be found throughout their summer range.

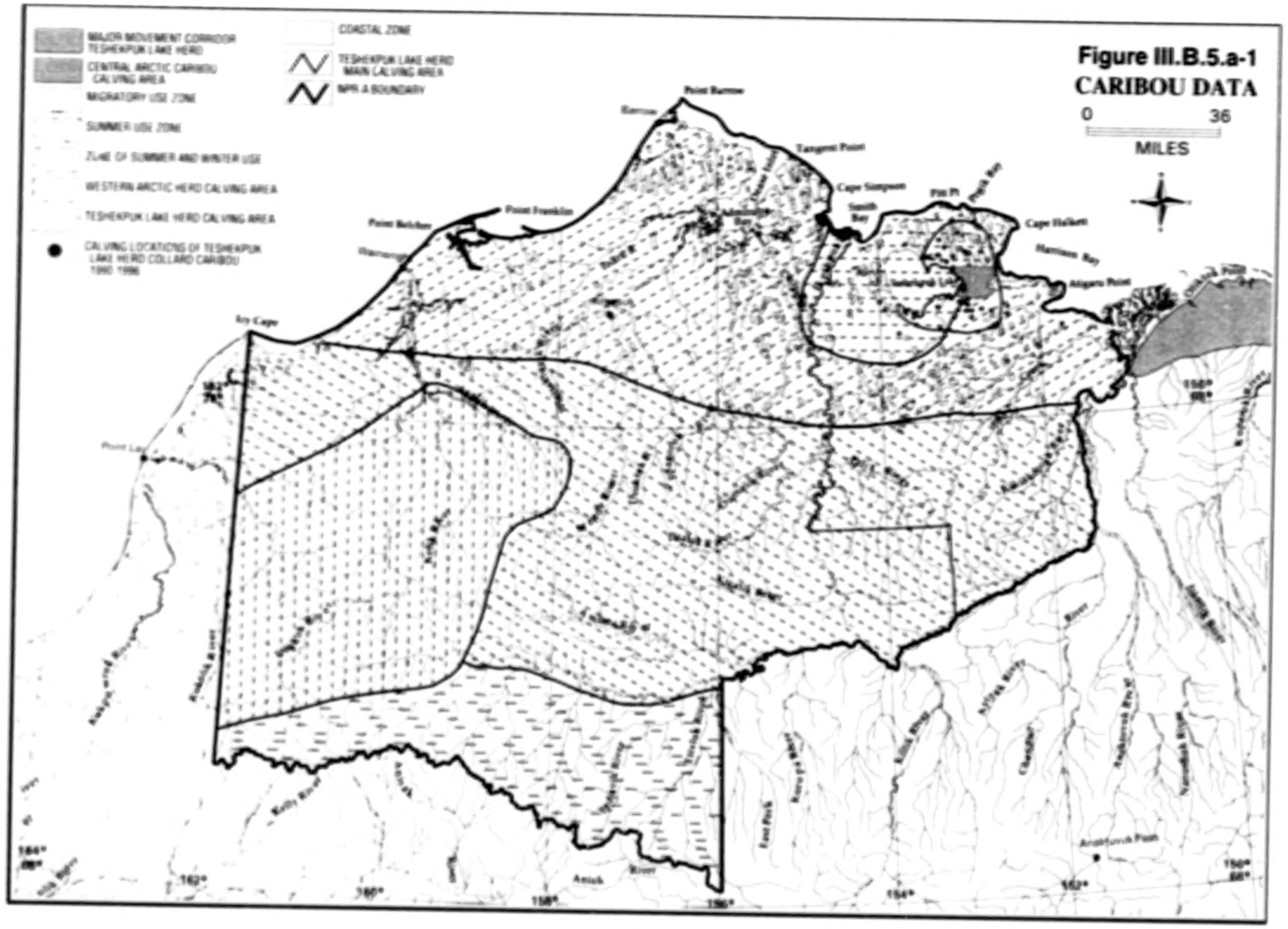
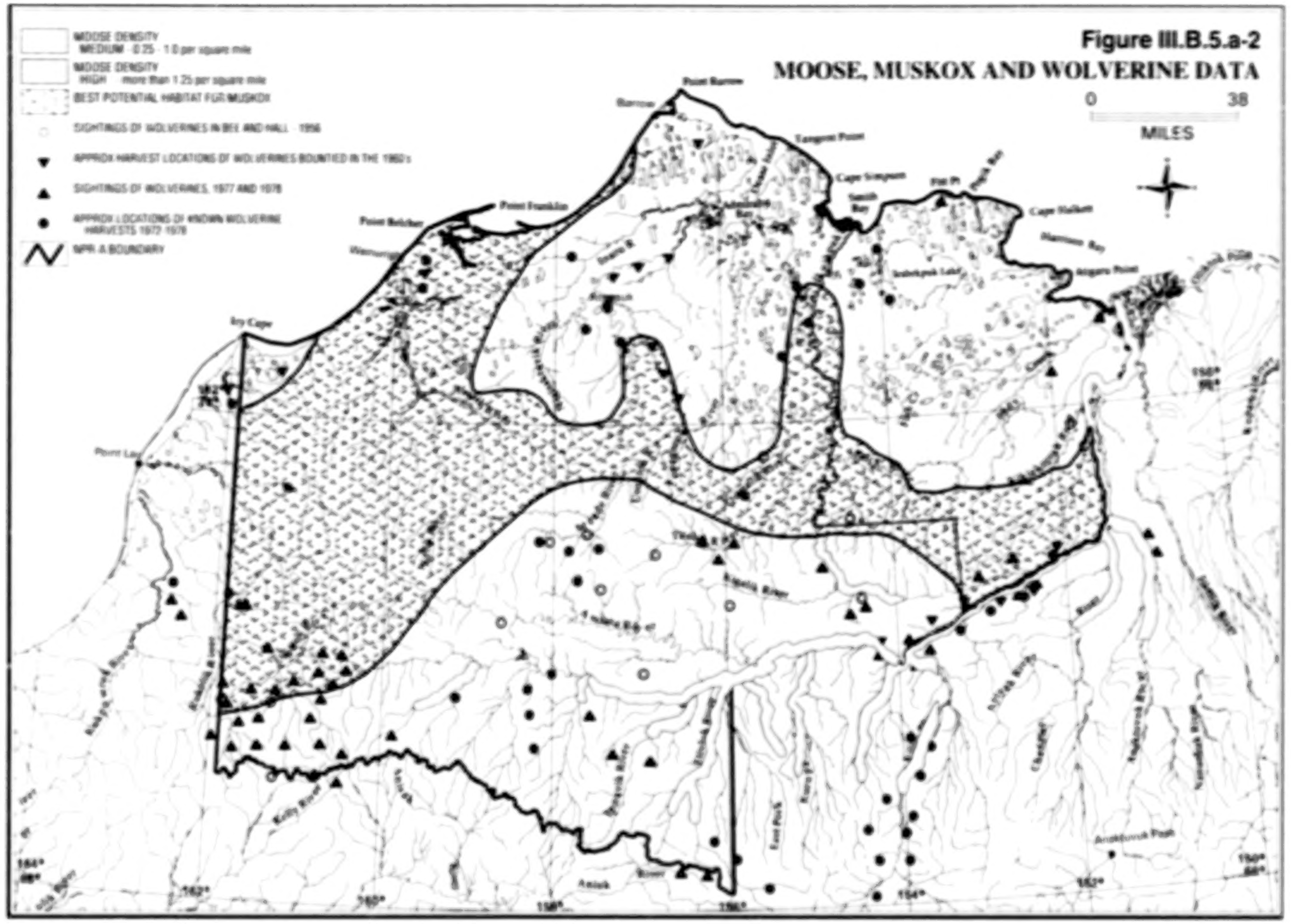


Figure III.B.5.a-1
CARIBOU DATA

BEST COPY AVAILABLE

176



MOOSE DENSITY
MEDIUM - 0.25 - 1.0 per square mile
MOOSE DENSITY
HIGH - more than 1.25 per square mile
BEST POTENTIAL HABITAT FOR MUSKOX
SIGHTINGS OF WOLVERINES IN BEE AND HALL - 1956
APPROX HARVEST LOCATIONS OF WOLVERINES BOUNTIED IN THE 1960's
SIGHTINGS OF WOLVERINES, 1977 AND 1978
APPROX LOCATIONS OF KNOWN WOLVERINE HARVESTS 1977-1978
NPR-A BOUNDARY
0
38
MILES
Point Barrow
Barrow
Tangent Point
Cape Simpson
Smith Bay
Pitt Pt
Cape Halkett
Harrison Bay
Atigaru Point
Point Franklin
Point Belcher
Wainwright
Icy Cape
Point Lay
Kelly River
Anaktuvuk Pass
164°
162°
160°
158°
156°
154°
152°
150°

Figure III.B.5.a-2

MOOSE, MUSKOX AND WOLVERINE DATA

BEST COPY AVAILABLE

Insect-relief areas become important during late June to mid-August during the insect season (Lawhead, 1997). Insect harassment reduces foraging efficiency and increases physiological stress (Reimers, 1980). Caribou use various coastal and upland habitats for relief from insect pests, areas where stiff breezes prevent insects from concentrating and alighting on the caribou, such as sandbars, spits, river deltas, some barrier islands, mountain foothills, snow patches, and sand dunes. In the planning area, members of the TLH generally aggregate close to the coast for insect relief. But some small groups gather in other cool, windy areas such as the Pik Sand Dunes located about 30 km south of Teshekpuk Lake (Hemming, 1971; Philo, Carroll, and Yokel, 1993). Caribou aggregations move frequently from insect-relief areas along the arctic coast (CAH, WAH and, especially, the TLH) and in the mountain foothills (some aggregations of the WAH) to and from green foraging areas.

(e) Winter-Range Use and Distribution: Caribou of the WAH generally reach their winter ranges in early to late November and remain on the range through March (Hemming, 1971; Henshaw, 1968). The primary winter range of the WAH is located south of the Brooks Range along the northern fringe of the boreal forest. During winters of heavy snowfall or severe ice-crusting, caribou may overwinter within the mountains or on the Arctic Slope (Hemming, 1971). Even during normal winters, some caribou of the WAH overwinter on the Arctic Coastal Plain (Fig. III.B.5.a-1). The TLH was believed to reside year-round in the Teshekpuk Lake area (Davis, Valkenburg, and Boertje, 1982); however, satellite collar data from TLH caribou indicate that some animals travel great distances to the south, as far as the Seward Peninsula (Carroll, 1992). The CAH overwinters primarily in the northern foothills of the Brooks Range (Roby, 1980).

The movement and distribution of caribou over the winter ranges reflect their need to avoid predators and their response to wind (storm) and snow conditions (depth and snow density), which greatly influence the availability of winter forage (Henshaw, 1968; Bergerud, 1974; Bergerud and Elliot, 1986). The numbers of caribou using a particular portion of the winter range are highly variable from year to year (Davis, Valkenburg, and Boertje, 1982; Fancy et al., 1990, as cited in Whitten, 1990). Range condition, distribution of preferred winter forage (particularly lichens), and predation pressure all affect winter distribution and movements (Roby, 1980; Miller, 1974; and Bergerud, 1974).

(2) Muskoxen: Indigenous populations of muskoxen were extirpated in the 1800's in northern Alaska (Smith, 1989). Muskoxen were reintroduced east of the NPR-A on the ANWR in 1969 and in the Kavik River area (between Prudhoe Bay and the ANWR) in 1970; they were reintroduced west of the NPR-A near Cape Thompson in 1970 and 1977 (Smith, 1989). The reintroductions to the east established the ANWR population, which grew rapidly and expanded both east and west of the ANWR (Garner and Reynolds, 1986). An estimated 270 muskoxen were counted between the Colville River and the ANWR, 91 animals were recorded west of the TAPS near the Colville River (Whitten, 1997, pers. comm.), and a breeding population has become established in the Itkillik-Colville rivers area (Johnson et al., 1996). The latter is the closest known breeding population to the planning area. The number of muskoxen that occur within the planning area is unknown. Probably a transitory number of lone bulls frequent the planning area, coming from populations that breed east of the Colville River. Muskoxen are expected to repopulate their former home-range habitats in the NPR-A in the near future (McCabe, 1977, pers. comm.). The most important habitats for muskoxen in the Colville River Delta are riparian, upland shrub and moist sedge-shrub meadows (Johnson et al., 1996). The best potential habitat for muskoxen in the planning area is shown in Figure III.B.5.a-2.

(3) Moose: Moose have been documented on the North Slope since the 1800's, and breeding populations have been reported in the western North Slope since the 1920's (Coady, 1980). The State of Alaska, Department of Fish and Game (ADF&G) Game Management Unit (GMU) 26A covers the western North Slope, including the NPR-A. From the 1960's to the 1980's, the numbers of moose increased on the western North Slope. The number of moose was estimated to be 1,500 animals in 1970 and 2,330 in 1984, of which 1,400 were spotted in the Colville River drainage (Trent, 1986). Other than the Colville River area, only the upper Ikpikpuk River is known to support wintering moose within the planning area (Whitten, 1997). Over the past few years, moose numbers on the North Slope have declined dramatically, and a decline of about 50 percent has been seen along the Colville River (Machida, 1995). The 1995 estimate for the Colville River area was about 760 (USDOI, BLM, 1996). Causes for the decline are unknown but may include disease, increased predation, and poor nutrition (exacerbated by severe winter weather and/or excessive insect harassment in summer) (Whitten, 1997). The primary habitat of moose along the Colville is riparian floodplain, with tall shrubs the predominant and preferred browse species (Mould, 1979).

(4) Grizzly Bear: The grizzly bear population on the western North Slope was considered stable or slowly increasing in 1991. Densities were highest in the foothills of the Brooks Range and lowest in the northern portion of the NPR-A (Carroll, 1991). On the North Slope, grizzly bear densities vary from about 0.3 to 5.9 bears/100 mi^2, with a mean density of one bear/100 mi^2. In 1989, the population of the western North Slope (GMU 26A) was estimated at between 500 and 720 bears (Trent, 1986; Carroll, 1991). The number of grizzly bears using the Prudhoe Bay and Kuparuk oilfields east of the NPR-A has increased in recent years: 27 bears were captured and marked by ADF&G in studies of bear use of the oilfields (Shideler and Hechtel, 1995). These bears have very large home ranges (2,600–5,200 km^2) and travel up to 50 km a day (Shideler and Hechtel, 1995). On the North Slope, grizzly dens occur in pingos, banks of rivers and lakes, sand dunes, and steep gullies in uplands (Harding, 1976; Shideler and Hechtel, 1995). The grass meadows on the bluffs along the Colville River are used by foraging bears during the spring (Swem, 1997, pers. comm.).

(5) Wolf: Following the prohibition of aerial wolf hunting (1970) and land-and-shoot hunting (1982), wolf populations have increased in the Brooks Range (Carroll, 1994). Although the wolf population of the western North Slope (GMU 26A) has not been determined since 1982, recent sample surveys estimate the population at 240 to 390 wolves in 32 to 53 packs (Carroll, 1994). The highest abundance of wolves within the NPR-A generally occurs along the Colville River (Fig. III.B.5.a-2), with densities of about 4.1 wolves/1,000 km^2 (Bente, 1996). Much lower densities are expected to occur on the coastal plain. Wolves tend to prefer upland and mountain habitats, where alternate prey species and better denning habitat is available.

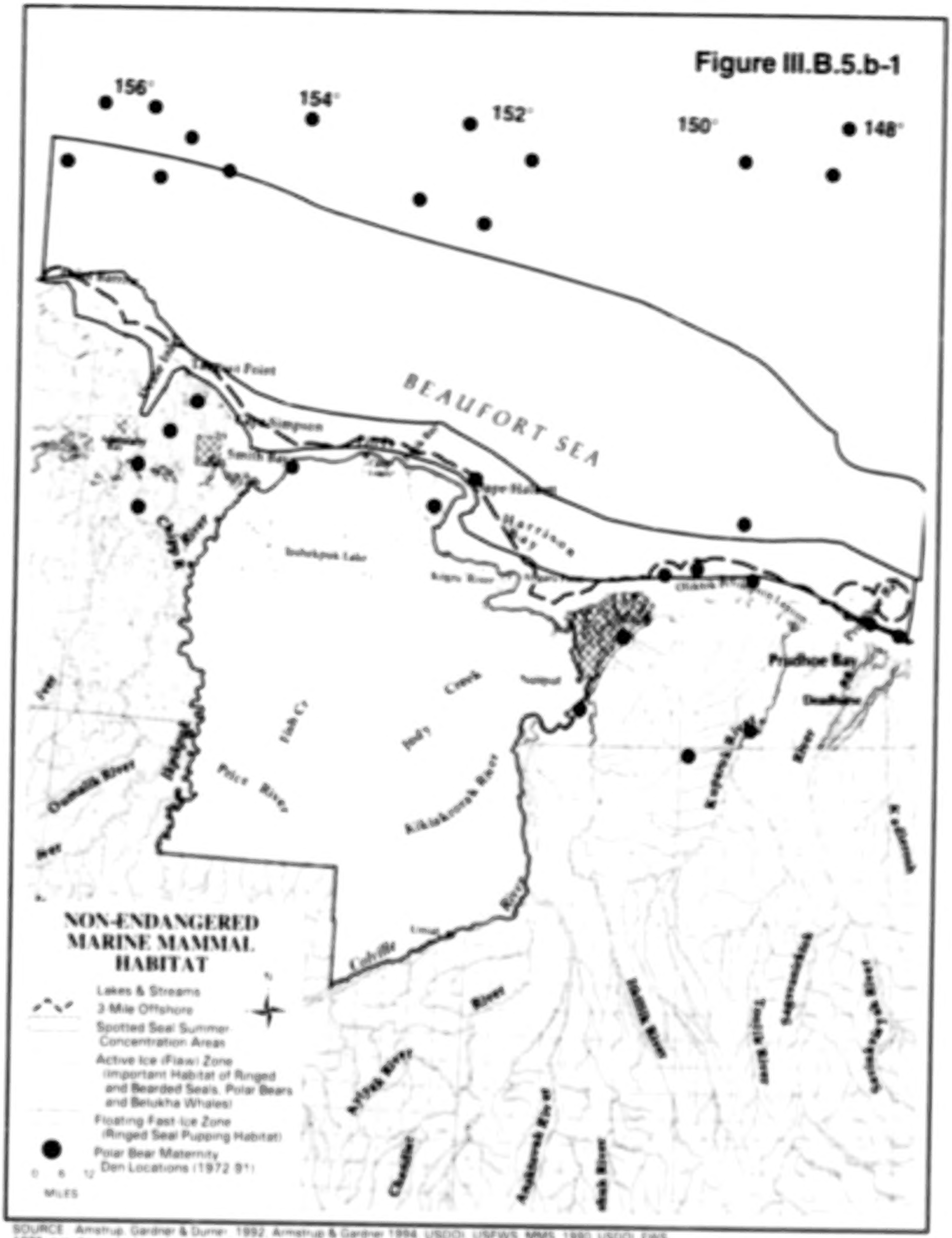
(6) Wolverine: Wolverines occur throughout the North Slope but are most common in the Brooks Range and foothills (Bee and Hall, 1956). A minimum wolverine population for the western North Slope (GMU 26A) was estimated at over 820 animals, based on a density of one wolverine/54 mi^2 (Trent, 1986). Denning areas on the North Slope probably are fell fields with deep snow cover, while tussock meadows, riparian willow, and alpine tundra are major habitat types used by wolverines (USDOI, BLM, 1978). Wolverines are both predators and scavengers of caribou and are found in association with caribou calving and postcalving areas; stomach contents of wolverines harvested in the northern NPR-A have consisted primarily of caribou (USDOI, NPR-A, 1978). Sightings of wolverines in the NPR-A are shown in Figure III.B.5.a-2. The wolverine also is important as a subsistence species for its fur, which is used in Native parkas (Reardon, 1981).

(7) Arctic Fox: The arctic fox population on the North Slope probably has increased with the decline of white-fox-pelt value and harvest rates since 1929 (Chesemore, 1967). Peak fox populations naturally are associated with high lemming abundance, their primary prey. Other food sources include ringed seal pups and the carcasses of other marine mammals and caribou, which are important throughout the year (Chesemore, 1967; Hammill and Smith, 1991). However, tundra-nesting birds form a large part of their diet during the summer (Chesemore, 1967; Fay and Follmann, 1982; Quinlan and Lehnhausen, 1982; Raveling, 1989). The availability of winter food sources has a direct effect on fox abundance and productivity (Angerbjorn et al., 1991). Arctic foxes in the Prudhoe Bay oilfield area readily use development sites for feeding, resting, and denning; and their densities are greater in the oilfields than in surrounding undeveloped areas (Eberhardt et al., 1982; Burgess et al., 1993). However, arctic foxes are particularly subject to rabies outbreaks; and their populations tend to fluctuate with the occurrence of the disease as well as with changes in food availability.

b. Marine Mammals: This account emphasizes species of marine mammals, other than endangered whales, commonly occurring in the habitats of the Alaskan Beaufort Sea that may be affected by onshore activities (or related offshore activities) in the NPR-A. Species covered include the ringed, bearded, and spotted seals; polar bear; and belukha whale. Other species that occasionally occur in small numbers (<100–<10) offshore of the planning area include the gray whale, walrus, harbor porpoise, killer whale, narwhal, and hooded seal. Due to the relative numerical insignificance of the latter species, they are not expected to be exposed to or affected by any activities associated with development and, therefore, are not discussed further. All marine mammals in U.S. waters are protected under the Marine Mammal Protection Act (MMPA) of 1972. In the Act, it was the declared intent of Congress that marine mammals "be protected and encouraged to develop to the greatest extent feasible commensurate with sound policies of resource management, and that the primary objective of their management should be to maintain the health and stability of the marine ecosystem." Habitat areas of marine mammals adjacent to the planning area are shown on Figure III.B.5.b-1.

(1) Ringed Seal: This species, widely distributed throughout the Arctic, is the most abundant seal in the Beaufort Sea. In the Alaskan Beaufort, the estimated population is 80,000 seals in the summer and 40,000 seals in the winter (Frost and Lowry, 1981). Ringed seal densities adjacent to the planning area may depend on a variety of factors, such as food availability, proximity to human disturbance, water depth, and ice stability. Densities of ringed seals in the floating shorefast-ice zone of the Beaufort Sea generally range from 1.5 to 2.4 seals per square nautical mile (2.8-4.4 seals/km^2) (Frost, Lowry, and Burns, 1988). Surveys in May of 1996 recorded densities of 0.30 to 0.62 seals/km^2 in the fast-ice habitat of the Beaufort Sea (Frost et al., 1997). Although ringed seals do not occur in large herds, loose aggregations of tens or hundreds of animals do occur, probably in association with abundant prey.

Figure III.B.5.b-1


156°
154°
152°
150°
148°
BEAUFORT SEA
Cape Simpson
Smith Bay
Cape Halkett
Harrison Bay
Teshekpuk Lake
Prudhoe Bay
Colville River
Fish Cr
Judy Creek
Price River
Kikiakrorak River
Kuparuk River
NON-ENDANGERED MARINE MAMMAL HABITAT
Lakes & Streams
3 Mile Offshore
Spotted Seal Summer Concentration Areas
Active Ice (Flaw) Zone (Important Habitat of Ringed and Bearded Seals, Polar Bears and Belukha Whales)
Floating Fast-Ice Zone (Ringed Seal Pupping Habitat)
Polar Bear Maternity Den Locations (1972 91)
0
6
12
MILES
N

SOURCE Amstrup, Gardner & Durner 1992, Armstrup & Gardner 1994, USDOI, USFWS, MMS, 1990, USDOI, FWS 1995-including polar bear den locations identified by polar bear huntings from Nuiqsut and Kaktovik

BEST COPY AVAILABLE

180

Probably a polygamous species, ringed seals, when sexually mature, establish territories during the fall that they maintain during the pupping season. Pups are born in late March and April in lairs that are excavated in snowdrifts and pressure ridges. During the pupping and breeding season, adults on the floating shorefast ice (Fig. III.B.5.b-1) generally are less mobile than individuals in other habitats; they depend on a relatively small number of holes and cracks in the ice for breathing and foraging. During nursing (4-6 weeks), pups generally are confined to the birth lair. This species is a major subsistence resource, composing as much as 58 percent of the total seals harvested by subsistence hunters in Alaska.

(2) **Bearded Seal**: This species is found throughout the Arctic and generally prefers areas where seasonal broken sea ice occurs over waters <200 m deep. The bearded seal primarily is restricted to the moving ice in the Beaufort Sea. Densities of bearded seals in the western Beaufort Sea and adjacent to the planning area are greatest during the summer and lowest during the winter. The most important winter and spring habitat area is the active ice (flaw-zone) shown in Figure III.B.5.b-1. The bearded seal is an important subsistence species and is preferred by subsistence users.

(3) **Spotted Seal**: This species is a seasonal visitor to the Beaufort Sea. Spotted seals appear along the coast in July in low numbers (about 1,000 for the entire Alaskan Beaufort coast), hauling out on beaches, barrier islands, and remote sandbars on the river deltas. Beaufort Sea coastal haulout and concentration areas near the NPR-A include the Colville delta, Peard Bay, and Oarlock Island in Dease Inlet/Admiralty Bay (Fig. III.B.5.b-1). Recently, these seals also have frequented Smith Bay at the mouth of the Piasuk River, just west of the planning area. Spotted seals frequently enter estuaries and sometimes ascend rivers, presumably to feed on anadromous fishes. Spotted seals migrate out of the Beaufort Sea in the fall (September to mid-October) as the shorefast ice re-forms and the pack ice advances southward. They spend the winter and spring periods along the ice front in the Bering Sea, where pupping, breeding, and molting occur.

(4) **Polar Bear**: Polar bears are found throughout the Arctic. The Beaufort Sea population (from Point Barrow to Cape Bathurst, Northwest Territories) is estimated to be 1,300 to 2,500 bears (1,778 population midpoint). This population has increased over the past 20 to 30 years at >2 percent/year, is believed to be stable or increasing slightly at present, and may be approaching carrying capacity (Amstrup, 1995; USDOI, FWS, 1995). There is substantial annual variation in the seasonal distribution and local abundance of polar bears in the Alaskan Beaufort Sea adjacent to the NPR-A. Average density was estimated to be one bear every 78 to 130 km^2 (30-50 mi^2), with much lower densities occurring farther than 100 mi offshore, and higher densities occurring near ice leads where seals are concentrated (Amstrup, 1983). The overall density from Point Barrow and Cape Bathurst was estimated at one bear every 141 to 269 km^2 (54-103 mi^2) (Amstrup, Stirling, and Lentfer, 1986). The two most important natural factors affecting polar bear distributions are sea ice and food availability.

Pregnant and lactating females and newborn cubs are the only polar bears that occupy winter dens for extended periods. Polar bears may concentrate such denning on offshore islands and certain portions of the mainland. Typically, dens are more sparsely distributed in the NPR-A coastal zone than in areas receiving consistent use, such as Wrangell Island in Russia and Hudson and James Bays in Canada (Jonkel et al., 1972). Pregnant females come to coastal areas in late October or early November to construct maternity dens. Most terrestrial dens are located close to the seacoast, usually not more than 8 to 10 km inland; but some dens have been located over 100 mi inland in Canada (Kolenosky and Prevett, 1983). Offspring are born from early December to late January (Harington, 1968), and females and cubs emerge from dens in late March or early April. On land, land dens usually are found along bluffs and inland along river/creek drainages within 25 mi of the coast (USDOI, FWS, 1995). Polar bear dens have been located along river banks in northeast Alaska and on shorefast ice close to islands east of the Colville River. Denning areas have been found along the coast of the planning area near Cape Halkett, Smith Bay, Atigaru Point, and the Colville River delta (USDOI, FWS, 1995). A recent trend for polar bear to increasingly use terrestrial habitats for denning along the Beaufort Sea coast has been observed (Amstrup and Garner, 1994). Recorded den locations from 1972 to 1991 are indicated on Figure III.B.5.b-1. The clumped distribution shown in Figure III.B.5.b-1 may be related to the greater topographic relief east of 146°59" W. longitude or to weather, ice conditions, and prey availability . Topographic relief provides areas where snow will accumulate in drifts on the leeward side of banks and other topographic features adequate for den construction by the bears. Several of the coastal den sites shown in Figure III.B.5.b-1 from the Colville delta east to Barter Island were identified by polar bear hunters from Nuiqsut and Kaktovik (USDOI, FWS, 1995).

Female polar bears generally do not use the same den-site location twice (Ramsay and Stirling, 1990; Amstrup, Garner, and Durner, 1992). Polar bears repeatedly may use the same geographic areas for maternity denning (Amstrup, Garner, and Durner, 1992; Amstrup and Garner, 1994), but short term annual shifts in the distribution of den locations have been reported in Canada and might be related to changes in sea-ice conditions (Ramsay and Stirling, 1990).

Denning polar bears may be sensitive to human disturbance.

Besides being covered by the MMPA of 1972, polar bears and their habitats are protected by the International Agreement on the Conservation of Polar Bears of 1976 between Canada, Denmark, Norway, the Union of Soviet Socialist Republics, and the United States. This agreement addresses the protection of "habitat components such as denning and feeding sites and migration patterns." Also, a bilateral agreement between the U.S. and Russia for the conservation of polar bears in the Chukchi and Bering Seas has been proposed (USDOI, FWS, 1997).

(5) **Belukha Whale**: The belukha whale, a subarctic and arctic species, is a summer visitor throughout offshore habitats of the Alaskan Beaufort Sea. The Beaufort population may exceed 42,500 whales (Hill, DeMaster, and Small, 1996). Most of this population migrates from the Bering Sea into the Beaufort Sea in April or May. However, some whales may pass Point Barrow as early as late March and as late as July (Frost, Lowry, and Burns, 1988). The spring-migration routes through ice leads are similar to those of the bowhead whale. A major portion of the Beaufort Sea population concentrates in the Mackenzie River estuary during July and August (Fig. III.B.5.b-1). An estimated 2,500 to 3,000 belukhas summer in the northwestern Beaufort and Chukchi seas, with some using coastal areas such as Peard Bay and Kasegaluk Lagoon (Frost, Lowry, and Burns, 1988; Frost, Lowry, and Carroll, 1993).

Fall migration through the western Beaufort Sea and offshore of the NPR-A occurs in September or October. Although small numbers of whales have been observed migrating along the coast (Johnson, 1979), surveys of fall distribution strongly indicate that most belukhas migrate farther offshore along the pack-ice front (Frost, Lowry, and Burns, 1988; Treacy, 1996). Belukha whales are an important subsistence resource of Inuit Natives in Canada and also are important locally to Inupiat Natives in Alaska.

6. Endangered and Threatened Species:

The Endangered Species Act of 1973 (ESA) defines an endangered species as any species that is in danger of extinction throughout all or a significant portion of its range. The Act defines a threatened species as one that is likely to become endangered within the foreseeable future. The endangered bowhead whale occurs seasonally in the Beaufort Sea adjacent to the planning area, the threatened spectacled eider occurs seasonally in the planning area, and the threatened Steller's eider may occur seasonally in the planning area. No critical habitat has been identified for any of these species. The descriptions of these species, as contained in Section III of the Beaufort Sea Sale 144 Final EIS (USDOI, MMS, 1996a), are herein incorporated by reference. A summary of the descriptions, supplemented by additional materials, follows. In addition, the National Marine Fisheries Service (NMFS) referenced additional species that could be affected along transportation routes south of the proposed sale area from Alaskan ports such as Valdez or Cook Inlet to potential U.S. West Coast ports in the waters of Alaska, Washington, Oregon, and California. Included in this section are the endangered Snake River sockeye salmon, the threatened Snake River chinook salmon, both the spring/summer and fall runs; the endangered Sacramento River winter-run chinook salmon; the threatened central California coastal coho salmon; the threatened southern Oregon/northern California coast coho salmon; two Evolutionarily Significant Units (ESU's) of steelhead that the NMFS has listed as endangered; three ESU's of steelhead that the NMFS has listed as threatened; and five ESU's of steelhead that the NMFS is proposing to list. Two candidate steelhead ESU's also are included. Species under the FWS jurisdiction that are included in this section are the endangered tidewater goby, the proposed threatened Sacramento splittail, and the endangered Suisun thistle. Because the consultation process has not been completed yet, additional species may be included in the FEIS. Also incorporated by reference are descriptions of additional species along the oil-transportation route from Alaskan ports such as Valdez or Cook Inlet to U.S. West Coast ports, previously referenced by the FWS as contained in Section III of the following documents: Cook Inlet Planning Area Oil and Gas Lease Sale 149 FEIS (USDOI, MMS, 1996b), the Gulf of Alaska/Yakutat Planning Area Oil and Gas Lease Sale 158 DEIS (USDOI, MMS, 1995), and the Biological Evaluations prepared for the ESA Section 7 consultations for both of those sales. A description of species along transportation routes to ports in the Far East is included in the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a).

a. Migratory Species Occurring in and Adjacent to the Planning Area:

(1) **Bowhead Whale**: The Bering Sea or western Arctic stock of bowhead whales was estimated to number from 7,200 to 9,400 individuals in 1993, with 8,200 as the best estimate of the population. It is estimated the western Arctic stock increased at a rate of 3.2 percent/year from 1978 to 1993 (*Zeh*, Raftery, and Schaffner, 1996). The historic population has been estimated from 10,400 to 23,000 whales in 1848 prior to commercial exploitation, compared to an estimate of between 1,000 and 3,000 animals in 1914 near the end of the commercial-whaling period.

Bowhead whales migrate semiannually through the Beaufort Sea offshore of the planning area while traveling between wintering areas in the Bering Sea and summer feeding grounds in the Canadian Beaufort Sea. During the winter, they are associated with the marginal ice zone, regardless of where the zone is located, and with polynyas in the Bering Sea along the northern Gulf of Anadyr, south of Saint Matthew Island, and near Saint Lawrence Island.

During the northward spring migration, bowheads pass through the Bering Strait and eastern Chukchi Sea from late March to mid-June through, or relatively near, newly opened leads in the shear zone between the shorefast ice and the offshore pack ice. After passing Barrow from April through mid-June, they head east moving through or near offshore leads. Bowheads arrive on their summer feeding grounds near Banks Island from mid-May through June and remain in the Canadian Beaufort Sea and Amundsen Gulf until late August or early September. Some whales may occur regularly in the Chukchi Sea along the northwestern Alaskan coast in late summer, but it is unclear whether these are "early autumn" migrants or whales that have summered nearby.

After summer feeding in the Canadian Beaufort Sea, bowheads begin moving westward into Alaskan waters in August and September. Typically, the major portion of the migration occurs between early to mid-September and mid-October. The medium water depth over which the greatest number of whales appears to migrate is from 22 to 55 yards (yd). An analysis of median water depths of bowheads sighted during fall aerial surveys from 1982 through 1995 provides an overall median depth of 40 yd for all years combined (Treacy, 1996). Miller, Elliot, and Richardson (1996) observed that whales within the Northstar region (147°-150° W. long.) migrate closer to shore in light and moderate ice years with medium distances offshore of 19 to 25 mi in both cases, and farther offshore in heavy ice years with medium distances offshore of 37 to 43 mi.

Data on the bowhead fall migration through the Chukchi Sea is limited. After moving south through the Chukchi Sea, bowheads pass through the Bering Strait in late October through early November on their way to wintering areas in the Bering Sea.

Bowheads apparently feed throughout the water column, including bottom or near-bottom feeding and surface feeding. Carbon-isotope analysis of bowhead baleen indicates that a significant amount of feeding may occur in wintering areas. Bowheads may feed opportunistically where food is available as they migrate through the Alaskan Beaufort Sea. Food items most commonly found in the stomachs of harvested bowheads include euphausiids, copepods, mysids, and amphipods, with euphausiids and copepods being the primary prey species.

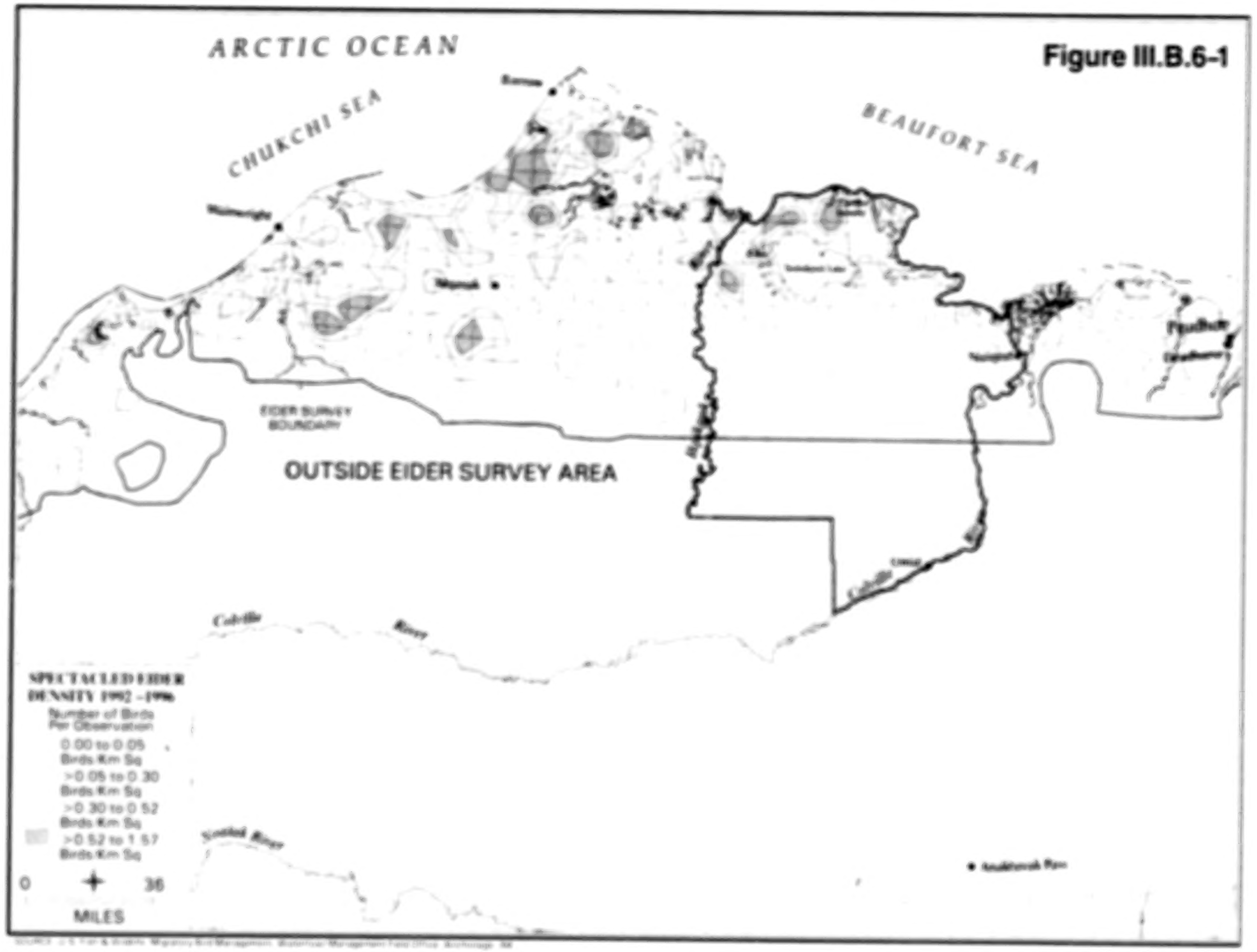
Bowhead whale mating season isn't known with certainty, although most bowhead mating and calving appear to occur from April through mid-June, coinciding with the spring migration.

(2) Spectacled Eider: Spectacled eiders were designated as threatened under the Endangered Species Act on May 10, 1993, due to a large decline in the North American population (58 *FR* 27474). Population estimates on one of its principal breeding ranges in Alaska, the Yukon-Kuskokwim (Y-K) Delta, prior to 1972 ranged from 47,700 nesting pairs in an average year, to as many as 70,000 pairs in "good years" (Dau and Kistchinski, 1977). It was estimated that the population had declined by 94 to 98 percent since the early 1970's, to 1,700 to 3,000 pairs in 1990 to 1992. Surveys of nesting populations in the Prudhoe Bay area suggest that this population has also declined (Warnock and Troy, 1992). However, no data are available for examining overall trends on the North Slope (USDOI, FWS, 1996). Native elders from Wainwright and Barrow residents observed evidence of local population declines elsewhere on the Arctic Coastal Plain (USDOI, FWS, 1994, and Suydam, 1996, pers. comm., as cited in USDOI, MMS, 1996a).

Recent surveys near Prudhoe Bay indicate the population has fluctuated since 1991 but suggest a trend of increasing abundance, with an estimated 49 pairs in 1991, 45 pairs in 1992, 85 pairs in 1993, 101 pairs in 1994, and 81 pairs in 1995 (Troy Ecological Research Associates [TERA], 1996). Extrapolation of the densities recorded in the study area to the remainder of the Arctic Coastal Plain corroborate the finding of regional studies conducted by Larned and Balogh (1994) that the spectacled eider population on the North Slope may be much larger than previously supposed, perhaps on the order of 20,000 to 30,000 birds (TERA, 1995). Such extrapolation probably is speculative, because it includes a small portion of the total spectacled eider habitat on the North Slope.

Aerial surveys on the coastal plain for spectacled eiders during 1993 to 1996 resulted in population estimates (uncorrected for visibility) of ~9,300, 7,000, 7,300, and 5,800, respectively (Larned, 1997, pers. comm.). Larned and Balogh (1994) observed spectacled eiders throughout the survey area from the mouth of the Canning River to 50 km south of Point Lay, but they were most abundant within 60 km of the coast between Barrow and Wainwright, and in the Teshekpuk Lake area. Balogh (1997) stated that aerial surveys on the NPR-A do not indicate a trend in spectacled eider numbers, and that variability in survey estimates can be attributed mostly to survey timing. Aerial surveys indicate that nesting spectacled eiders within the planning area are most abundant in the Colville River delta area and within 30 km inland from the coast from Atigaru Point to the Ikpikpuk River.

Figure III.B.6-1


ARCTIC OCEAN
CHUKCHI SEA
BEAUFORT SEA
Barrow
Wainwright
Atqasuk
EIDER SURVEY BOUNDARY
OUTSIDE EIDER SURVEY AREA
Colville River
Umiat
Anaktuvuk Pass
SPECTACLED EIDER DENSITY 1992 - 1996
Number of Birds Per Observation
0.00 to 0.05 Birds/Km Sq
>0.05 to 0.30 Birds/Km Sq
>0.30 to 0.52 Birds/Km Sq
>0.52 to 1.57 Birds/Km Sq
0
36
MILES

SOURCE: U.S. Fish & Wildlife, Migratory Bird Management, Waterfowl Management Field Office, Anchorage, AK

BEST COPY AVAILABLE

184

BLANK PAGE

Spectacled eiders arrive at breeding areas in the arctic portion of their range in late May to early June (USDOI, FWS, 1996). Their primary nesting grounds on the Arctic Coastal Plain are west of the Sagavanirktok River, and nesting locations appear to be most abundant in the western portions of the coastal plain. Female spectacled eiders are present on the coastal plain from May to September. Males take no role in incubating or broodrearing and begin leaving breeding areas during incubation. A substantial proportion of the males have departed the breeding area by late June (USDOI, FWS, 1996). Spectacled eiders equipped with radio-transmitters lingered in Harrison Bay and other Beaufort Sea nearshore locations for 1 to 2 weeks after departing the Prudhoe Bay area. After this, the eiders moved toward the Chukchi Sea, with individuals recorded in the Teshekpuk Lake area as well as coastal locations as far west as Barrow (Petersen, 1997, pers. comm.).

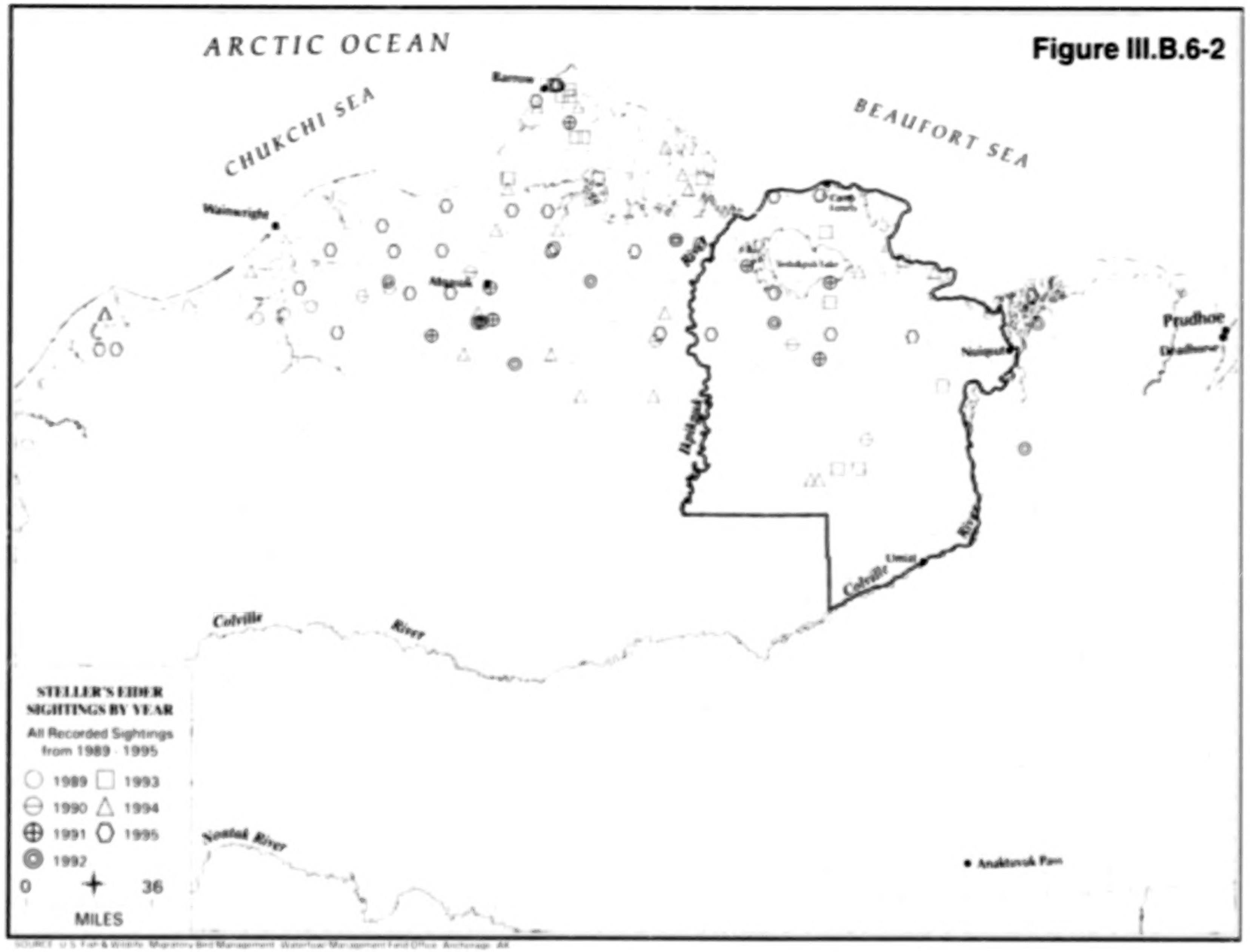
Eiders nest on major river deltas such as the Colville; on tundra with lakes; and in areas of wet, polygonized coastal plain with numerous waterbodies (USDOI, FWS, 1996). Balogh (1997) observed that wetlands most often used by eiders in the NPR-A were large (>1 km diameter) emergent wetlands with *Arctophila fulva*, high shoreline development and vegetated islands that were generally not part of a notable fluvial system. Nesting begins in mid-June, and eggs start hatching in mid-July. A variety of habitat types are used during prenesting, but 86 percent of observations were in three habitat types: aquatic grass, basin wetland complexes, and aquatic sedge (Anderson, Stickney, and Ritchie, 1996). Nests are dispersed and eiders nest at low density. Densities in the Prudhoe Bay area during 1991 to 1995 range from 0.20 to 0.49 pairs/mi^2 (TERA, 1996). Nest success typically ranges from 10 to 80 percent but can be as high as 95 percent in some instances, such as on Kigigak Island, where foxes were removed prior to the nesting season (USDOI, FWS, 1996). Nesting success during 1991 and 1993 to 1995 was estimated to be between 25 and 40 percent for birds nesting in the Kuparuk and Prudhoe Bay oilfields (USDOI, FWS, 1996). Broodrearing in the Kuparuk, Milne Point, and Prudhoe Bay oilfields occurs primarily in waterbodies with margins of emergent grasses and sedges, basin wetland complexes, and occasionally deep open-water lakes (ARCO, 1996). Eiders feed on aquatic crustaceans, aquatic insects, and plant material while on their coastal breeding grounds (58 *FR* 27474).

Satellite-tagged postbreeding birds from the North Slope have been relocated in Ledyard Bay, a primary Alaskan molting area, and in several other coastal areas from the Beaufort Sea to the Y-K Delta and Russian Far East and scattered localities near Saint Lawrence Island (Petersen, Douglas, and Mulcahy, 1995, as cited in USDOI, MMS, 1997). Subsequent aerial surveys have revealed large molting concentrations of birds in Ledyard Bay and Norton Sound in Alaska and in Mechigmenskiya in the Russian Far East (Larned et al., 1993, 1994, and 1995). In March 1995, the FWS located a large proportion of the world's spectacled eider population (an estimated 140,000 birds) wintering in pack ice in the central Bering Sea, about halfway between Saint Matthew and Saint Lawrence Islands. In early April an aerial photo census revealed 148,000 ± 10,000 at that location. In March 1996, wintering spectacled eiders were found less densely concentrated in extensive open water 80 km northwest of the 1995 distribution. A photo census was unsuccessful, but numbers were roughly estimated at about 200,000 (Larned, 1997, pers. comm.). Eiders were found at this same location in March 1997, and a nearly complete photo census revealed nearly 400,000 birds (Larned, 1997, pers. comm.). Prior to these observations, the major wintering area for spectacled eiders was unknown.

(3) Steller's Eider: In 1994, the FWS proposed to list the Alaska breeding population of the Steller's eider as threatened (59 *FR* 35896). The Steller's eider population, estimated at 150,000 to 200,000 individuals rangewide, has declined by about 50 percent since the early 1970's (59 *FR* 35896). Steller's eiders were designated as threatened under the Endangered Species Act on June 11, 1997, due to a substantial decrease in the species' nesting range (62 *FR* 31748). The Final Rule stated that the status of Steller's eiders worldwide has been poorly documented. It indicated there is concern that Steller's eiders may be declining rangewide, but the magnitude of any change in population size is unknown because of a lack of precise population estimates. Spring-migration surveys in Alaska estimated the population of Steller's eiders migrating along the eastern Bering Sea coast at 138,000 in 1992, 89,000 in 1993, 108,000 in 1994, and 90,000 in 1997 (Larned, 1997, pers. comm.). An unknown but presumably smaller number migrates along the coast of the western Bering Sea.

In Alaska, Steller's eiders now breed almost exclusively on the Arctic Coastal Plain (59 *FR* 35896). The Steller's eider is apparently almost extinct as a breeding bird on the Y-K Delta. Once considered a common breeding bird on the Y-K Delta, it had not been found nesting since 1975 until recently, despite recent extensive geographic coverage of waterfowl habitats and ground searches of historically important nesting areas (Kertell, 1991). However, a breeding pair was observed on the Y-K Delta in 1994 and again in 1996 (Flint, 1997, pers. comm.). Recent Steller's eider population size estimates on the coastal plain are based on a few sightings during aerial waterfowl-breeding-pair surveys. Population estimates are considered very imprecise but ranged from about 2,000 to 7,000 individuals from 1989 to 1992 (Brackney and King, 1993, as cited in 59 *FR* 35896). No Steller's eiders were observed in 1986 to 1988.

Figure III.B.6-2

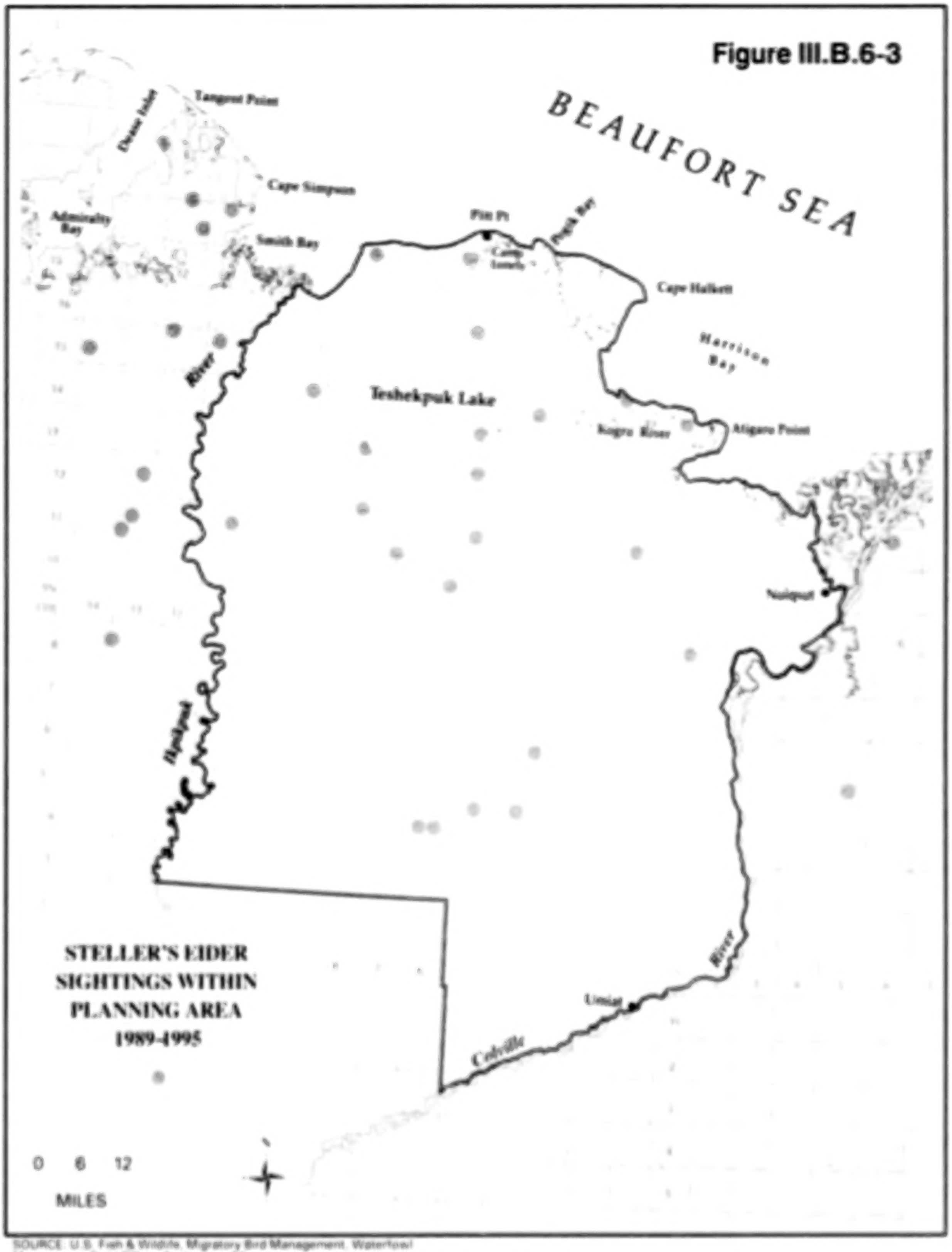


SOURCE: U.S. Fish & Wildlife, Migratory Bird Management, Waterfowl Management Field Office, Anchorage, AK

EST COPY AVAILABLE

BLANK PAGE

Figure III.B.6-3



STELLER'S EIDER SIGHTINGS WITHIN PLANNING AREA 1989-1995

SOURCE: U.S. Fish & Wildlife, Migratory Bird Management, Waterfowl Management Field Office, Anchorage, AK.

BEST COPY AVAILABLE

Steller's eider-nesting habitat in northern Alaska is characterized by low relief tundra with numerous lakes and ponds (especially ponds with *Arctophila* and *Carex*), polygonized tundra, and small streams (Quakenbush et al., 1995). Steller's eiders near Barrow apparently do not nest every year (Quakenbush et al., 1995; Suydam, 1997). Current information indicates that nesting densities on the Arctic Coastal Plain are highest near Barrow, where eiders still occur regularly though not annually. In some years, up to several dozen pairs may breed in approximately a 1-mi² area (62 *FR* 31748). The breeding range probably extends from about Point Lay to the vicinity of the Colville River Delta (ARCO, 1996). The Final Rule (62 *FR* 31748) states that the current breeding distribution of Steller's eiders encompasses the arctic coastal regions of northern Alaska from Wainwright to Prudhoe Bay up to 90 km inland. Although relatively few Steller's eiders have been observed between Barrow and the Colville River, about 1,000 pairs or more may nest in northwestern Alaska (Brackney and King, 1993, as cited in 59 *FR* 35896). Native residents reported that Steller's eiders were common breeders in the 1930's on the central North Slope at the Colville delta and eastern North Slope at Camden Bay (Patkotak, 1993, pers. comm., as cited in 59 *FR* 35896), but Anderson (as cited in 59 *FR* 35896) considered them rare east of Barrow. Breeding pairs of Steller's eiders were not observed east of the Colville River after 1973, despite an increasing number of observers (North, 1990, as cited in Quakenbush and Cochrane, 1993). A few Steller's eiders were seen regularly in the vicinity of Prudhoe Bay in the 1980's and five birds were seen there in 1993 (TERA, 1993, as cited in Quakenbush and Cochrane, 1993). A few pairs were seen near Prudhoe Bay each year between 1992 and 1994 (FWS, 1997) and females with young were reported in 1993 (62 *FR* 31748).

Alaskan Steller's eiders are coastal migrants through the western Beaufort, Chukchi, and Bering seas. Most of the world's Steller's eiders winter along the Alaska Peninsula from the eastern Aleutian Islands to southern Cook Inlet in shallow, nearshore marine waters (59 *FR* 35896). Izembek Lagoon is one of the most important molting and wintering areas due to its extensive eelgrass beds and associated invertebrate fauna (Jones, 1965, as cited in Quakenbush et al., 1995). Pair bonding occurs in the wintering areas in March and April. Pairs arrive on the breeding grounds near Barrow in early June (Quakenbush and Cochrane, 1993). Males depart the nesting areas in late June, soon after incubation begins. Females with broods remain until late August or early September. Reproductive success generally is low with occasional good years, suggesting that productivity is highly dependent on adult survival. Eiders feed on aquatic crustaceans, aquatic insects, molluscs, and plant material during their breeding season (Quakenbush and Cochrane, 1993). Chironomids (midge larvae) are the predominant macrobenthic invertebrate found in arctic tundra ponds.

b. Migratory Species Occurring Along the Marine Transportation Routes (Washington, Oregon, and California):

(1) Snake River Sockeye Salmon: The Snake River sockeye salmon were listed as endangered November 20, 1991 (56 *FR* 58619). Redfish Lake supports the only remaining run of Snake River sockeye salmon and the world's southernmost natural sockeye salmon population.

Snake River sockeye salmon enter the Columbia River primarily during June and July. Arrival into Redfish Lake peaks in August and spawning occurs near the shoals along the lake's shoreline primarily in October (56 *FR* 14055). Shoal spawning is less typical of sockeye salmon than spawning in lake tributary or inlet streams. Eggs hatch in the spring between 80 and 140 days after spawning. Fry remain in the gravel for 3 to 5 weeks, emerging in April through May and, if hatched in inlet or outlet streams, moving immediately into the lake, where juveniles feed on plankton for 1 to 3 years before migrating to the ocean. Juvenile residence of sockeye salmon in Redfish Lake rarely exceeds 2 years.

Migrants leave Redfish Lake in late April through May and smolts migrate almost 900 mi to the ocean, where they remain inshore or within their home rivers' influence zone for the early summer. Later, they migrate through the northeast Pacific Ocean. There is no information on ocean distribution of these salmon, although they are assumed to migrate into the Gulf of Alaska. Snake River sockeye salmon usually spend 2 years in the ocean and return in their fourth or fifth year of life to spawn. The survival rate for Snake River sockeye salmon from the time they migrate from the lake to their return as adults is between 0.14 and 1.83 percent (56 *FR* 14055).

The abundance of Snake River sockeye salmon in the ocean probably is a few tens of fish or perhaps a few hundred fish. Based on counts at Ice Harbor Dam in the lower Columbia River, the Snake River sockeye salmon return has averaged <150 fish per year since 1975, when the lower Snake River hydroelectric system was completed. Since 1985, the Ice Harbor Dam count has been <25 fish annually. One fish was counted in 1990 and nine fish in 1991.

(2) Snake River Spring/Summer Chinook Salmon: Snake River spring/summer chinook salmon were listed as threatened on April 22, 1992 (57 *FR* 14653). There is evidence that the Snake River spring/summer chinook salmon are reproductively isolated from Snake River fall chinook salmon. Adult chinook salmon migrating past the Bonneville Dam from March-May, June-July, and August-October are categorized as spring-, summer-, and fall-run fish, respectively. In general, habitats for spawning and early juvenile rearing are different among the three forms. Spring chinook salmon tend to use small, higher elevation streams; summer chinook salmon tend to use midelevation streams; and fall chinook salmon use larger, lower elevation mainstem streams.

The Snake River contains five principal subbasins that currently produce spring- and/or summer-run chinook salmon. The habitat occupied by spring/summer chinook salmon in the Snake River is unique to the biological species. Snake River spring/summer chinook salmon spawn at higher elevations, typically about 5,000 to 7,000 ft. They also migrate farther from the ocean, 600 to 900 mi, than most other chinook salmon populations.

Snake River spring/summer chinook salmon have declined to low numbers of fish that are thinly spread over a large and complex river system. Redd counts, which are used as an indicator of trends and status of population of the species, have declined sharply over the last 33 years. In 1957, over 13,000 redds were counted in index areas, excluding the Grande Ronde River. The counts, including the Grande Ronde River, dropped to a minimum of 620 redds in 1980. After a gradual increase to 3,395 redds in 1988, the number of redds dropped to 1,008 and 1,224 in 1989 and 1990, respectively. Based on redd counts, the estimated number of salmon passing over the Lower Granite Dam averaged 9,674 fish from 1980 through 1990, with a low count of 3,343 fish in 1980 and a high count of 21,870 fish in 1988.

Snake River spring/summer chinook salmon migrate seaward as yearling smolts. Naturally spawned and reared outmigrating Snake River chinook salmon smolts are not tagged with coded wire tags, so information on their distribution at sea is limited. Tag recovery from fish that are hatchery reared and released indicates the distribution of Snake River chinook salmon primarily is along the northern Oregon and Washington coast. Exceptions have been documented as far south as California and as far north as Prince William Sound in the Gulf of Alaska. The spawning age of Snake River spring/summer chinook salmon varies by stream and by sex, but the data indicate that most return after 2 or 3 years. Egg- to -smolt survival varies, and the data are limited. The survival rate in the Tucannon River was 13.0 percent for the 1985 brood year and 14.2 percent for the 1987 brood year, whereas the survival rate in the Grande Ronde River varied from 6.4 to 8.0 percent from 1965 through 1969 (56 *FR* 29542). There are no data available for smolt-to-adult survival for individual streams or drainages, although it was estimated that the 0.4 to 4.4 percent smolt-to-adult survival rate for wild smolts arriving at the Ice Harbor Dam was for 1966 to 1975. Outmigrating Snake River spring/summer chinook salmon are present at Lower Granite Dam (the first major dam encountered by the outmigrants) generally from early April through June (56 *FR* 29542).

(3) Snake River Fall Chinook Salmon: Snake River fall chinook salmon were listed as threatened on April 22, 1992 (57 *FR* 14653). There is evidence that the Snake River fall chinook salmon are reproductively isolated from Snake River spring/summer chinook salmon. Adult chinook salmon migrating past Bonneville Dam from August to October are categorized as fall run fish. Fall chinook salmon tend to use larger, lower elevation mainstem streams as habitat for spawning and early juvenile rearing.

Snake River fall chinook salmon have declined substantially in abundance with returns of very small numbers in recent years, and they currently are limited to a fraction of their former range. Yearly adult counts at the uppermost Snake River mainstem project averaged 12,720 from 1964 through 1968, 3,416 from 1969 through 1974, and 610 from 1975 through 1980. Counts of natural spawning Snake River fall chinook salmon at the Lower Granite Dam during 1985 to 1991 ranged from 79 to 449 fish and averaged 314 fish. In 1992, 533 spawners were counted (Faris, 1993).

The Columbia River fall chinook salmon run has five major components, of which the Snake River fall chinook salmon are part of the Upriver Bright stock complex. The life history for Snake River fall chinook salmon includes emergence from the gravel in March and April and migration to the ocean within a few weeks of emergence. Naturally spawned and reared outmigrating Snake River chinook salmon smolts are not tagged with coded wire tags, so information on their distribution at sea is limited. Tag recovery from fish that are hatchery reared and released indicates the distribution of Snake River chinook salmon primarily is along the northern Oregon and Washington coast. Exceptions have been documented as far south as California and as far north as Prince William Sound in the Gulf of Alaska. Data indicate that Snake River fall chinook salmon return to the Snake River at ages 2 to 5, with 3 to 4 years being the most common spawning ages.

(4) Southern Oregon/Northern California Coast Coho Salmon: The Southern Oregon/Northern California Coast Evolutionary Significant Unit (ESU) of coho salmon was listed as threatened on May 6, 1997 (62 *FR* 24588). This ESU is composed of populations between Punta Gorda, Humboldt County, California, and Cape Blanco, Oregon.

Coho salmon on the West Coast of the contiguous U.S. and much of British Columbia generally exhibit a relatively simple 3-year lifecycle. Adults typically begin their freshwater spawning migration in the late summer and fall, spawn by midwinter, and then die. The run and spawning times vary between and within coastal and Columbia River Basin populations. Depending on river temperatures, eggs incubate in redds for 1.5 to 4.0 months before hatching as alevins (a larval lifestage dependent on food stored in a yolk sac). Following yolk-sac absorption, alevins emerge from the gravel as young juveniles or fry and begin actively feeding. Juveniles rear in freshwater for up to 15 months, then migrate to the ocean as smolts in the spring. Coho salmon typically spend two growing seasons in the ocean before returning to their natal stream to spawn as 3-year olds. Some precocious males, called jacks, return to spawn after only 6 months at sea (62 *FR* 24588).

Historically, this species probably inhabited most coastal streams in Washington, Oregon, and northern and central California. Some populations, now extinct, are believed to have migrated hundreds of miles inland to spawn in tributaries of the upper Columbia River in Washington and the Snake River in Idaho. In the 1940's, estimated abundance of coho salmon in this ESU ranged from 150,000 to 400,000 naturally spawning fish. Today, coho populations in this ESU are very depressed, currently numbering approximately 10,000 naturally produced adults. Populations in the California portion of this ESU could be < 6 percent of their abundance during the 1940's, while Oregon populations have exhibited a similar but slightly less-severe decline. It is important to note that population abundance in the Rogue River Basin has increased substantially over the last 3 years. The bulk of current coho salmon production in this ESU consists of stocks from the Rogue River, Klamath River, Trinity River, and Eel River basins. Smaller basins known to support coho salmon include the Elk River in Oregon, and the Smith and Mad Rivers and Redwood Creek in California (62 *FR* 24588).

The present depressed condition of this population is the result of several longstanding, human-induced factors. The major activities responsible for the decline of coho salmon in Oregon and California are logging, road building, grazing and mining activities, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals, and unscreened diversions for irrigation.

(5) Central California Coast Coho Salmon. The Central California Coast ESU of coho salmon was listed as threatened on October 31, 1996 (61 *FR* 56138). This ESU is composed of populations of all coho salmon naturally reproduced in streams between Punta Gorda, Humboldt County, California, and the San Lorenzo River, Santa Cruz County, California. Life-history information, historical distribution information, and causes for the decline in the population presented above for the southern Oregon northern California coast coho salmon are also pertinent for this ESU of coho.

In the 1940's, the estimated abundance of coho salmon in this ESU ranged from 50,000 to 125,000 natural spawning adults. Today, it is estimated that there probably are < 6,000 naturally reproducing coho salmon, and the vast majority of these fish are considered to be of non-native origin (either hatchery fish or from streams stocked with hatchery fish) (61 *FR* 56138).

(6) Sacramento River Winter-Run Chinook Salmon: The Sacramento River winter-run chinook salmon were reclassified from threatened to endangered on January 4, 1994 (59 *FR* 440). The NMFS also has designated the Sacramento River from Keswick Dam, Shasta County (River Mile 302), to Chipps Island (River Mile 0) at the westward margin of the Sacramento-San Joaquin River delta as critical habitat (58 *FR* 33212). Additional waters designated as critical habitat also are described in that Final Rule. The Sacramento River winter-run chinook salmon is a unique population distinguishable from other chinook salmon runs in the Sacramento River based on the timing of its upstream migration and spawning period. For the most part, the winter-run chinook salmon population is comprised of 3 year- classes, each of which primarily returns to spawn as 3-year-old fish.

The winter-run chinook has declined more than 97 percent over a period of 20 years. The decline primarily is due to water-management projects that have modified the river and eliminated spawning habitat through water diversion, which lowers the water level in the river and raises the temperature to a level that is lethal to salmon eggs.

The winter-run chinook begin returning from the sea during the winter and migrate from the Sacramento-San Joaquin Delta up to the upper Sacramento River to spawn. They spawn primarily between Red Bluff Diversion Dam and Keswick Dam on the upper Sacramento River from late April to mid-August, with a peak in May and June. The eggs incubate and hatch in about 2 months. If water temperature is too high, especially during the peak incubation and hatching months of July through September, the eggs do not hatch. The juveniles emerge in late June through September and begin their downstream migration within several weeks of hatching. The seaward migration may continue into the spring months.

The best available data on winter-run chinook salmon abundance are the annual estimates of the spawning-run size made by the California Department of Fish and Game (CDF&G) based on counts of fish passing the Red Bluff

Diversion Dam. The CDF&G began estimating the annual-run size for winter-run chinook salmon in 1967 after the dam was placed in operation. This time series of annual-run-size estimates documented a precipitous decline in the winter-run chinook salmon—from an estimated 117,808 fish in 1969 to 341 in 1993 (59 *FR* 440).

(7) Umpqua River Cutthroat Trout: The Umpqua River cutthroat trout was listed as endangered on August 9, 1996 (61 *FR* 41514). The life history of this subspecies probably is the most complex and flexible of any Pacific salmonid. Unlike other anadromous salmonids, sea-run forms of the coastal cutthroat trout do not overwinter in the ocean and only rarely make long, extended migrations across large bodies of water. They migrate in the nearshore marine habitat and usually remain within 10 km of land. While most anadromous cutthroat trout enter seawater as 2- or 3-year olds, some may remain in freshwater up to 5 years before entering the ocean. Others may never outmigrate at all, but remain as residents of small headwater tributaries. Some may migrate only into rivers and lakes, even when they have access to the ocean. In the Umpqua River, anadromous, resident, and potamodromous (river-migrating) life-history forms have been reported (61 *FR* 41514).

In general, land use practices have reduced salmonid production by decreasing habitat diversity and complexity and accelerating the frequency and magnitude of natural events, such as flooding and drought. Extensive documentation regarding the impacts of land use practices on the Umpqua River cutthroat trout presently is not available, although there appears to be a close relationship between various fish-habitat parameters and the land-management history of streams in the Umpqua National Forest (61 *FR* 41514).

(8) Steelhead: On August 9, 1996, NMFS issued a proposed rule to list five ESU's as endangered and five ESU's as threatened under the Endangered Species Act (61 *FR* 41541). On August 18, 1997, NMFS subsequently issued a Final Rule listing two ESU's (Southern California and Upper Columbia River) as endangered and three ESU's (Central California Coast, South-Central California Coast, and Snake River Basin) as threatened (62 *FR* 43937). The NMFS has extended the deadline for five other ESU's (Lower Columbia River, Oregon Coast, Klamath Mountains Province, Northern California, and California Central Valley) for 6 months to solicit, collect, and analyze additional information (62 *FR* 43974). All of the following information about steelhead was obtained from 61 *FR* 41541.

Steelhead exhibit one of the most complex suites of life-history traits of any salmonid species. Steelhead may exhibit anadromy (meaning that they migrate as juveniles from freshwater to the ocean and then return to spawn in freshwater) or freshwater residency (meaning that they reside their entire life in freshwater). Resident forms usually are referred to as rainbow trout, while anadromous lifeforms are termed steelhead. Few detailed studies have been conducted regarding the relationship between resident and anadromous forms and, as a result, the relationship between these two lifeforms is poorly understood. The scientific name for the biological species that includes both steelhead and rainbow trout recently was changed from *Salmo gairdneri* to *Oncorhychus mykiss* to reflect the premise that all trouts from western North America share a common lineage with Pacific salmon.

Steelhead typically migrate to marine waters after spending 2 years in freshwater. They then reside in marine waters for typically 2 or 3 years prior to returning to their natal stream to spawn as 4- or 5-year olds. Unlike Pacific salmon, steelhead are capable of spawning more than once before they die. However, it is rare for steelhead to spawn more than twice before dying; most that do so are females. Steelhead adults typically spawn between December and June (Bell, 1990, as cited in 61 *FR* 41541). Depending on water temperature, steelhead eggs may incubate in redds for 1.5 to 4 months before hatching as alevins. Following yolk-sac absorption, alevins emerge from the gravel as young juveniles or fry and begin actively feeding. Juveniles rear in freshwater from 1 to 4 years, then migrate to the ocean as smolts.

Biologically, steelhead can be divided into two reproductive ecotypes, based on their state of sexual maturity at the time of river entry and the duration of their spawning migration. These two ecotypes are termed "stream maturing" and "ocean maturing." Stream maturing steelhead enter freshwater in a sexually immature condition and require several months to mature and spawn. Ocean maturing steelhead enter freshwater with well-developed gonads and spawn shortly after river entry. These two reproductive ecotypes are more commonly referred to by their season of freshwater entry (e.g., summer and winter steelhead).

Historically, steelhead likely inhabited most coastal streams in Washington, Oregon, and California as well as many inland streams in these states and Idaho. However, during this century, over 23 indigenous, naturally reproducing stocks of steelhead are believed to have been extirpated; and many more are thought to be in decline in numerous coastal and inland streams in Washington, Oregon, Idaho, and California.

The endangered steelhead ESU's are located in California (Southern California ESU) and Washington (Upper Columbia River ESU).

Southern California: This coastal steelhead ESU occupies rivers from (and including) the Santa Maria River to the southern extent of the species range, which presently is considered to be Malibu Creek in Los Angeles County. Migration and life-history patterns of southern California steelhead depend more strongly on rainfall and streamflow than is the case for steelhead populations farther north. River entry ranges from early November through June with peaks in January and February. Spawning primarily begins in January and continues through early June, with peak spawning in February and March. Average rainfall is substantially lower and more variable in this ESU than in regions to the north, resulting in increased duration of sand berms across the mouths of streams and rivers and, in some cases, complete dewatering of the marginal habitats. Environmental conditions in marginal habitats may be extreme (e.g., elevated water temperatures, droughts, floods, and fires) and presumably impose selective pressures on steelhead populations. Relatively little life-history information exists for steelhead from this ESU. Estimates of historical (pre-1960's) abundance for some of the major streams are as follows: Santa Ynez River (20,000-30,000), Ventura River (4,000-6,000), Santa Clara River (7,000-9,000), and Malibu Creek (1,000). The present total run size for these streams plus Gaviota Creek and Matilija Creek is estimated at <200 adults. The NMFS concludes that the Southern California steelhead ESU presently is in danger of extinction (61 *FR* 41541).

Upper Columbia River: This inland steelhead ESU occupies the Columbia River Basin upstream from the Yakima River, Washington, to the United States/Canada Border. The geographic area occupied by this ESU forms part of the larger Columbia Basin Ecoregion. The Wenatchee and Entiat rivers are in the Northern Cascades Physiographic Province, and the Okanogan and Methow rivers are in the Okanogan Highlands Physiographic Province. The river valleys in this region are deeply dissected and maintain low gradients, except in extreme headwaters. The climate in this area includes extremes in temperatures and precipitation, with most precipitation falling as snow in the mountains. Streamflow in this area is provided by melting snowpack, groundwater, and runoff from alpine glaciers. Life-history characteristics for Upper Columbia River Basin steelhead are similar to those of other inland steelhead ESU's; however, some of the oldest smolt ages for steelhead, up to 7 years, are reported from this ESU. This may be associated with the cold stream temperatures. Based on limited data available from adult fish, smolt age in this ESU is dominated by fish that are 2 years old. Steelhead from the Wenatchee and Entiat rivers return to freshwater after 1 year in saltwater, whereas most Methow River steelhead return to freshwater after 2 years in saltwater. Estimates of historical (pre-1960's) abundance from fish counts at the Rock Island Dam averaged 2,600 to 3,700, suggesting a run in excess of 5,000 adults for tributaries above the dam. Recent average total escapement for the Wenatchee River stock was 2,500 and for the Methow and Okanogan rivers stock was 2,400. The NMFS concludes that the Upper Columbia River steelhead ESU presently is in danger of extinction (61 *FR* 41541).

The threatened steelhead ESU's are dispersed throughout four states and include the Central California Coast, South-Central California Coast, and the Snake River Basin ESU's.

Central California Coast: This coastal steelhead ESU occupies river basins from the Russian River to Soquel Creek, Santa Cruz County (inclusive), and the drainages of San Francisco and San Pablo bays, except for the Sacramento-San Joaquin River Basin of the Central Valley of California. This area is characterized by very erosive soils in the coast-range mountains. Redwood forest is the dominant coastal vegetation for these drainages. Precipitation is lower here than in areas to the north, and elevated stream temperatures (>20 °C) are common in the summer. Only winter steelhead are found in this ESU. River entry ranges from October in the larger basins to late November in the smaller coastal basins and continues through June. Steelhead spawning begins in November in the larger basins and December in the smaller coastal basins and can continue through April, with peak spawning generally in February and March. Little other life-history information exists for steelhead in this ESU. In the mid-1960's it was estimated there were 94,000 steelhead spawning in many rivers in this ESU, including 50,000 and 19,000 fish in the Russian and San Lorenzo rivers, respectively. Recent estimates by NMFS for the Russian and San Lorenzo rivers were approximately 7,000 fish and 500 fish, respectively, indicating that recent total abundance in the two rivers is <15 percent of their abundance 30 years ago. The NMFS concludes that the Central California Coast steelhead ESU is presently in danger of extinction (61 *FR* 41541).

South-Central California Coast: This coastal steelhead ESU occupies rivers from the Pajaro River in Santa Cruz County, California, to (but not including) the Santa Maria River. Most rivers in this ESU drain the Santa Lucia Range, the southernmost unit of the California Coast Ranges. The climate is drier and warmer than in the north, which is reflected in the vegetational change from coniferous forest to chaparral and coastal scrub. The mouths of many of the rivers and streams in this area are seasonally closed by sand berms that form during periods of low flow in the summer. Only winter steelhead are found in this ESU. River entry ranges from late November through March, with spawning from January through April. Little other life-history information exists for steelhead in this ESU. In the mid-1960's, it was estimated that 27,750 steelhead were spawning in the rivers of this ESU. While no recent estimates for total run size exist for this ESU, recent estimates for those rivers where comparative abundance information is available show a substantial decline during the past 30 years. The NMFS concludes that the South-Central California Coast steelhead ESU presently is in danger of extinction (61 *FR* 41541).

Snake River Basin: This inland steelhead ESU occupies the Snake River Basin of southeast Washington, northeast Oregon, and Idaho. The Snake River flows through terrain that is warmer and drier on an annual basis than the upper Columbia Basin or other drainages to the north. The environmental factors of the Snake River Basin result in a river that is warmer and more turbid, with higher pH and alkalinity, than is found elsewhere in the range of inland steelhead. Snake River Basin steelhead are summer steelhead, as are most inland steelhead, and comprise two groups, A-run and B-run, based on migration timing, ocean age, and adult size. Snake River Basin steelhead enter freshwater from June to October and spawn in the following spring from March to May. A-run steelhead are thought to be predominantly fish with 1 year in the ocean, while B-run steelhead are thought to have been in the ocean for 2 years. Snake River Basin steelhead usually smolt at age 2 or 3 years. No estimates of historical (pre-1960's) abundance are available for this ESU. The trend in abundance for this ESU (indexed at the Lower Granite Dam) has been increasing since 1975, although natural escapement has been declining during the same period. Naturally produced escapement has declined sharply in the last 10 years. The NMFS concludes that the Snake River Basin steelhead ESU presently is not in danger of extinction but is likely to become endangered in the foreseeable future (61 *FR* 41541).

The NMFS has extended the final listing-determination deadline for the following proposed steelhead ESU's, which are dispersed throughout three states (Lower Columbia River, Oregon Coast, Klamath Mountains Province, Northern California, and California Central Valley ESU's).

Lower Columbia River: This coastal steelhead ESU occupies tributaries to the Columbia River between the Cowlitz and Wind rivers in Washington and the Willamette and Hood rivers in Oregon. Excluded are steelhead in the upper Willamette River Basin above Willamette Falls, and steelhead from the Little and Big White Salmon rivers in Washington. This ESU is composed of both winter and summer steelhead. Rivers draining into the Columbia River have their headwaters in increasingly drier areas moving from west to east. Columbia River tributaries that drain the Cascade Mountains have proportionally higher flows in late summer and early fall than rivers on the Oregon coast. This ESU is composed of both winter and summer steelhead. No estimates of historical (pre-1960's) abundance are available for this ESU. Total run sizes for the major stocks in the lower Columbia River for the early 1980's are estimated to be approximately 150,000 winter steelhead and 80,000 summer steelhead, but approximately 75 percent of the total run was estimated to be of hatchery origin. Of the 18 stocks for which adequate adult escapement-trend data exists, 11 have been declining and 7 increasing. The NMFS concludes that the Lower Columbia River steelhead ESU presently is not in danger of extinction but is likely to become endangered in the foreseeable future (61 *FR* 41541). The NMFS has extended the final listing determination deadline for this ESU.

Oregon Coast: This coastal steelhead ESU occupies river basins on the Oregon coast north of Cape Blanco, excluding rivers and streams that are tributaries of the Columbia River. Most rivers in this area drain the Coast Range Mountains, have a single peak in flow in December or January, and have relatively low flow during summer and early fall. The coastal region receives fairly high precipitation levels, and the vegetation is dominated by Sitka spruce and western hemlock. The Oregon Coast ESU primarily contains winter steelhead. There are only two native stocks of summer steelhead, which occur only in the Siletz River, above a waterfall, and in the North Umpqua River, where migration distance may prevent full use of available habitat by winter steelhead. Alsea River winter steelhead have been widely used for steelhead broodstock in coastal rivers. Little information is available regarding migration and spawn timing of natural steelhead populations within this ESU. Age structure appears to be similar to other West Coast steelhead, dominated by 4-year-old spawners. No estimates of historical (pre-1960's) abundance are available for this ESU except for counts at the Winchester Dam on the North Umpqua River. Estimated total run sizes for the major stocks for the early 1980's are estimated to be approximately 255,000 winter steelhead and 75,000 summer steelhead. It is estimated that 69 percent of the winter and 61 percent of the summer steelhead were of hatchery origin. Of the 42 stocks for which adequate adult escapement-trend data exists, 36 have been declining and 6 increasing. The NMFS concludes that the Oregon Coast steelhead ESU presently is not in danger of extinction but is likely to become endangered in the foreseeable future (61 *FR* 41541). The NMFS has extended the final listing determination deadline for this ESU.

Klamath Mountains Province: This coastal steelhead ESU occupies river basins from the Elk River in Oregon to the Klamath and Trinity rivers in California. Dominant vegetation along the coast is redwood forest, while some interior basins are much drier than surrounding areas. With the exception of major river basins such as the Rogue and the Klamath, most rivers in this region have a short duration of peak flows. Steelhead within this ESU include both winter and summer steelhead as well as the unusual "half-pounder" (characterized by immature steelhead that return to freshwater after only 2 to 4 months in saltwater, overwinter in rivers without saltwater, then return to saltwater the following spring). Although historical trends in overall abundance within the ESU are not clearly known, the NMFS believes there has been a substantial replacement of natural fish with hatchery-produced fish. Most natural populations of steelhead within the area experience a substantial infusion of naturally spawning hatchery fish each year (61 *FR* 41541). The NMFS has extended the final listing determination deadline for this ESU.

Northern California: This coastal steelhead ESU occupies river basins from Redwood Creek in Humboldt County, California, to the Gualala River. Dominant vegetation along the coast is redwood forest, while some interior basins are much drier than surrounding areas. Elevated stream temperatures is a factor affecting steelhead and other species in some of the larger river basins, but not to the extent that they are in river basins farther south. With the exception of major river basins such as the Eel, most rivers in this region have a short duration of peak flows. Steelhead within this ESU include both winter and summer steelhead, including what is presently considered to be the southernmost population of summer steelhead, in the Middle Fork Eel River. Half-pounder juveniles also occur in this area. As with the Rogue and Klamath rivers, some of the larger rivers in this area have migrating steelhead year-round. Entry into the river ranges from August through June and spawning from December through April, with peak spawning in January in the larger basins and late February and March in the smaller coastal basins. Historical (pre-1960's) abundance information for this ESU is available from dam counts in the upper Eel River (annual average of 4,400 adults in the 1930's), South Fork Eel River annual average of 19,000 in the 1940's), and Mad River (annual average of 3,800 adults in the (1940's). In the mid-1960's, it was estimated that steelhead spawning populations for many rivers in this ESU totaled 198,000 fish. While no overall recent abundance estimate for this ESU exists, the substantial declines in run size from historic levels at major dams in the region indicate a probable similar overall decline in abundance from historic levels. The NMFS concludes that the Northern California steelhead ESU is not presently in danger of extinction, but is likely to become endangered in the foreseeable future (61 *FR* 41541). The NMFS has extended the final listing determination deadline for this ESU.

California Central Valley: This coastal steelhead ESU occupies the Sacramento and San Joaquin rivers and their tributaries. In the San Joaquin Basin, however, the best available information suggests that the current range of steelhead has been limited to the Stanislaus, Tuolumne, and Merced rivers (tributaries), and the mainstem San Joaquin River to its confluence with the Merced River by human alteration of formerly available habitat. The Sacramento and San Joaquin rivers offer the only migration route to the drainages of the Sierra Nevada and southern Cascade mountain ranges for anadromous fish. Steelhead within this ESU have the longest freshwater migration of any population of winter steelhead. The valley is characterized by alluvial soils, and native vegetation was dominated by oak forests and prairie grasses prior to agricultural development. There is essentially one continuous run of steelhead in the upper Sacramento River. River entry ranges from July through May, with peaks in September and February. Spawning begins in late December and can extend into April. Historical (pre-1960's) abundance estimates for this ESU are not available. In 1961, it was estimated that the total run size in the Sacramento River, including San Francisco Bay, was 40,000 fish. Limited data exist on recent abundance for this ESU, but it is estimated that the present total run size probably is less than 10,000 fish. The NMFS concludes that the Central California Coast steelhead ESU presently is in danger of extinction (61 *FR* 41541). The NMFS has extended the final listing determination deadline for this ESU.

The two candidate steelhead ESU's are located in Oregon (Upper Willamette River) and Washington (Middle Columbia River).

Upper Willamette River: This coastal steelhead ESU occupies the Willamette River and its tributaries upstream from Willamette Falls. The native steelhead of this basin are late-migrating winter steelhead entering freshwater primarily in March and April, whereas most other populations of West Coast winter steelhead enter freshwater beginning in November or December. No estimates of historical (pre-1960's) abundance for this ESU are available. Hatchery fish are widespread and escape to spawn naturally throughout the region. The NMFS concludes that the Upper Willamette River steelhead ESU presently is not in danger of extinction, nor is it likely to become endangered in the foreseeable future (61 *FR* 41541).

Middle Columbia River Basin: This inland steelhead ESU occupies the Columbia River Basin from Mosier Creek, Oregon, upstream to the Yakima River, Washington, inclusive. Steelhead of the Snake River Basin are excluded. This region includes some of the driest areas of the Pacific Northwest, generally receiving <40 cm of rainfall annually. Vegetation is of the shrub-steppe province, reflecting the dry climate and harsh temperature extremes. All steelhead in the Columbia River Basin upstream from the Dalles Dam are summer-run, inland steelhead. Life- history information for steelhead of this ESU indicates that most steelhead smolt at 2 years and spend 1 to 2 years in saltwater prior to reentering freshwater, where they may remain up to a year prior to spawning. Estimates of historical (pre-1960's) abundance for this ESU indicate that the total historical run size might have been in excess of 300,000. The most recent 5-year average run size was 142,000, with a naturally produced component of 39,000. These data indicate approximately 74-percent hatchery fish in the total run to this ESU. The NMFS concludes that the Middle Columbia River steelhead ESU presently is not in danger of extinction but has reached no conclusion regarding its likelihood of becoming endangered in the foreseeable future (61 *FR* 41541).

(9) **Tidewater Goby**: The tidewater goby was listed as endangered on February 4, 1994 (59 *FR* 5494). The following information about its life history was obtained from 59 *FR* 5494. The tidewater goby is a fish that occurs in tidal streams associated with coastal wetlands in California. It is a small, benthic fish, rarely exceeding 2 in standard length, and is characterized by large pectoral fins and a ventral suckerlike disk formed by the complete fusion of the pelvic fins. The tidewater goby is almost unique among fishes along the U.S. Pacific Coast in its restriction to waters with low salinities in California's coastal wetlands. The tidewater goby does not have a marine life- history phase. All lifestages of tidewater gobies are found at the upper end of lagoons in salinities <10 parts per thousand (ppt). This lack of a marine phase severely restricts the frequency of genetic exchange between coastal lagoon populations and significantly lowers the potential for natural recolonization of a locality once extirpated. Tidewater gobies have a short lifespan and seem to be an annual species, further restricting their potential to recolonize habitats from which they have been extirpated. They occur in loose aggregations of a few to several hundred individuals on the substrate in shallow water <3 ft deep, although gobies have been observed at depths of approximately 5 to 8 ft. Peak nesting activities commence in late April through early May, when male gobies dig a vertical nesting burrow 4 to 8 in deep in clean, coarse sand. Suitable water temperatures for nesting are approximately 75 to 80 °F, with salinities of 5 to 10 ppt. Male gobies remain in the burrows to guard eggs, which are hung from the ceiling and walls of the burrow until hatching. Larval gobies are found midwater around vegetation until they become benthic. Although the potential for year-round spawning exists, it probably is unlikely because of seasonal low temperatures and disruptions of lagoons during winter storms. Studies performed at two sites documented spawning occurring as early as the first week in January.

This species has significantly declined throughout its historic range and continues to be threatened by loss and degradation of its coastal habitat. Since 1900, the tidewater goby has disappeared from nearly 50 percent of the coastal lagoons within its historic range, including 74 percent of the lagoons south of Morro Bay in central California. Only three populations currently exist south of Ventura County. The tidewater goby is discontinuously distributed throughout California, ranging from Tillas Slough (mouth of the Smith River) in Del Norte County south to Agua Hedionda Lagoon in San Diego County. Areas of precipitous coastlines that preclude the formation of lagoons at stream mouths have created three natural gaps in the distribution of the tidewater goby. Gobies are apparently absent from three sections of the coast between (1) Humboldt Bay and Ten Mile River, (2) Point Arena and Salmon Creek, and (3) Monterey Bay and Arroyo del Oso.

(10) **Sacramento Splittail**: The Sacramento splittail was proposed for listing as threatened on January 6, 1994 (59 *FR* 862). The following information about its life history was obtained from 59 *FR* 862. The Sacramento splittail is a large cyprinid that can exceed 16 in in length. Although primarily a freshwater species, the splittail can tolerate salinities as high as 10 to 18 ppt. Splittails are relatively long lived, with a life span of approximately 5 to 7 years. Females are highly fecund and produce over 100,000 eggs each year. Populations fluctuate annually depending on spawning success, which is highly correlated with freshwater outflow and the availability of shallow-water habitat with submerged vegetation. Fish usually reach sexual maturity by the end of their second year. The onset of spawning is associated with rising temperature, and peak spawning occurs from the months of March through May over flooded vegetation in tidal freshwater and euryhaline habitats of estuarine marshes and sloughs and slow-moving reaches of large rivers. Larvae remain in shallow, weedy areas close to spawning sites and move into deeper water as they mature. Splittails are benthic foragers that feed on opossum shrimp and detrital. They also feed on earthworms, clams, insect larvae, and other invertebrates.

Splittails are endemic to California's Central Valley, where they were once widely distributed. Historically, splittails were found as far north as Redding on the Sacramento River, as far south as the present-day site of Friant Dam on the San Joaquin River, and as far upstream as the current Oroville Dam site on the Feather River and Folsom Dam site on the American River. The species is now largely confined to the San Francisco Bay-Sacramento-San Joaquin River Estuary, including the delta, Suisun Bay, Suisun Marsh, and Napa Marsh. The Sacramento splittail has declined by 62 percent over the last 15 years.

(11) Suisun Thistle: The Suisun thistle was proposed for listing as endangered on June 12, 1995 (60 *FR* 31000). The following information about its life history was obtained from 60 *FR* 31000. The Suisun thistle is a perennial herb in the aster family. It occurs in either saltwater or brackish tidal marshes in the San Francisco Bay area of northern California and is currently restricted to two locations at Suisun Marsh in Solano County. The plant occurs in a very narrow tidal band, typically in higher elevation zones within larger tidal marshes that have fully developed tidal channel networks. The Suisun thistle usually does not occur in smaller fringe tidal marshes that generally are <300 ft in width or in nontidal areas. The population is thought to include a few thousand plants.

C. SOCIAL SYSTEMS:

1. Economy:

The most important potential economic effects of the proposed IAP/EIS for the NPR-A are anticipated to fall on the North Slope Borough (NSB), Southcentral Alaska, and the State of Alaska. Most economic benefits to the NSB government and residents would be derived from the oil and gas lease sale of the IAP, should one be held. Some of the other activities associated with the IAP (recreation, perhaps some aspects of the various cultural, paleontological, wildlife, and fish surveys) also may contribute to economic benefits, but these would be very small compare to those from oil and gas activities. The NSB government directly employs a significant numbers of people and finances construction projects under its Capital Improvement Program (CIP), which by itself has employed a significant number of people. The NSB expenditures have been funded in large part with property-tax revenues based on the oil facilities at and near Prudhoe Bay. With these revenues, the NSB government has provided greatly improved educational, health, and other government services and capital improvements. Effects of IAP oil and gas activity potentially are to continue the use of these facilities and expand the facilities from which NSB property-tax revenues are derived. The NSB also may derive some benefits from the State portion of the royalties shared by the Federal Government.

In the past, most workers at North Slope oil facilities centered at Prudhoe Bay commuted between worker enclaves on the North Slope and permanent residences in regions of the State outside of the NSB. However, only a small number of North Slope Native residents have worked at oil facilities at and near Prudhoe Bay, and this is very likely to be true in the future. Some workers are anticipated to commute between the enclaves and permanent residences outside of Alaska, especially during the exploration phase.

The NSB includes the entire northern coast of Alaska and encompasses 88,281 mi^2 of territory, equal to 15 percent of the land area of Alaska. Since oil development began on the North Slope, Inupiat residents have relied heavily for wage employment on jobs financed principally by the NSB. The predominantly Inupiat residents traditionally have relied on subsistence activities for food resources. Sociocultural aspects and subsistence activities of the economy are discussed in Sections III.C.3 (Subsistence) and III.C.4 (Sociocultural), respectively, of this IAP/EIS.

Employment in Southcentral Alaska associated with the NPR-A has been very low in recent years. Revenues to the State of Alaska associated with the NPR-A have been zero in recent years.

a. NSB Revenues and Expenditures:

The tax base that has allowed the recent high levels of local-government expenditures consists primarily of the enormously highly valued petroleum-industry-related property in the Prudhoe Bay area. In Fiscal Year (FY) 1995, more than 95 percent of revenues were generated by property tax, according to the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a, Sec. III.C.1).

Assessed NSB property value for FY 1986 through FY 1991 was approximately $12 to $13 billion. For FY 1991, all assessed property value was $13.1 billion, whereas assessed industrial-property value at Prudhoe Bay was $12.4 billion, or 95 percent of the total. Between 1982 and 1991, total NSB taxes collected peaked in FY 1987 at $249 million and declined in FY 1991 to $221 million (NSB, 1993:*NSB 1992 Economic Profile*, Volume VI). Revenues in FY 1992 were $229 million; FY 1993, $235 million; FY 1994, $224 million; and FY 1995, $227 million (Walters, 1997, pers. comm.).

The FY 1994 mill rate applied by the NSB to assessed property was 18.5 mills. This rate is the sum of a rate of 4.78 mills for operations and 13.72 mills for debt service. Although the mill rate for operations is at the limit allowed by State statutes, the NSB's total mill rate is well under the limit and, therefore, the NSB administration is not now facing any legal constraints to raising the rate (USDOI, MMS, 1996a:Sec. III.C.1). Because the NSB mill rate is below the limit means that short-term revenue constraints do not drive current expenditures. In the short term, a larger tax base resulting from NPR-A leasing potentially would enable a decline in the mill.

b. NSB Employment:

Civilian employment in the NSB grew from 1,600 persons in 1975 to a peak of about 2,000 persons in 1978 during the pipeline boom, dropped to 1,400 in 1980, climbed to 2,700 in 1986, and has been in the range of 2,800 to 3,000 persons between 1987 and 1995 (see Fig. III.C.1-1). The definition of employment for these data is for those employed who reside in the NSB. The definition used for the employment data in Figure III.C.1-2 is the number of persons who work in the NSB; in the case of the NSB, this definition includes the oil workers in and near Prudhoe Bay. Residency is a basic difference between the two sets of employment numbers, but there are other more technical differences in definitions that contribute only minor differences. The State of Alaska, Dept. of Labor (ADOL) cautions against comparing the two sets of numbers (Windisch-Cole, 1996, pers. comm.). The annual average nonagricultural employment for the NSB Census Area was approximately 9,400 persons in 1985, which dropped to 6,600 in 1986 and 1987, and rose to 7,600 in 1993 and 8,243 in 1994 (Fig. III.C.1-2). Mining employment fluctuated approximately between approximately 3,400 persons in 1991, dropped to 2,800 in

1993, and rose to 3,300 in 1994 (Fig. III.C.1-3). "Mining" is a category of the U.S. Dept. of Labor (USDOL), Bureau of Labor Statistics (BLS), that, in the case of the NSB, primarily reflects the employment of oil workers at Prudhoe Bay and adjoining areas. Construction employment fluctuated from approximately 500 persons in 1991 to a peak of 600 in 1994 (Fig. III.C.1-3), and local-government employment rose from approximately 1,800 persons in 1991 to 2,200 in 1994, reflecting the large number of NSB government employees.

Oil development at Prudhoe Bay and nearby areas, including the Trans-Alaska Pipeline System (TAPS), is the main driving force of employment in the NSB. Property taxes collected by the NSB from the oil development at Prudhoe Bay have enabled significant employment by the NSB and Native corporations. The NSB is the largest employer of North Slope residents in the region. In 1993, the NSB employed more than 45 percent of all working residents (or 897 persons), who provide a wide range of services, many of which are not found in other regions of the State. The NSB School District employed another 17 percent of the resident-employed workforce (or 346 persons). The District budget is controlled by the NSB government and in large part its revenues are derived from the NSB. The village corporations employed 16 percent or 308 persons. Major private employers are the Arctic Slope Regional Corporation, the Ukpeagvik Corporation, the other Alaska Native Claims Settlement Act (ANCSA) village corporations, and their subsidiaries and joint ventures. Most Native corporation employment is derived from contracts with the NSB. Over the 1975 to 1995 period, the NSB CIP has expended many millions of dollars and employed a substantial number of North Slope residents. Construction workers on all CIP projects in the 1989 to 1994 period were 68 percent NSB residents; of that total, 59 percent were Inupiat residents. However, on any given CIP project, the percent of non-NSB residents and non-Inupiat could be high. Since its incorporation, the NSB has implemented a program to improve skills of the residents and reduce unemployment (NSB, 1995:*NSB 1993/94 Economic Profile and Census Report*, Volume VII).

Unemployment has been in the 4- to 5-percent range in the 1975 to 1995 period, according to data (USDOL/BLS) obtained through the ADOL's *Historical Reports on Labor Force and Employment* (State of Alaska, Dept. of Labor, No date) (see Fig. III.C.1-1). The USDOL/BLS data, however, count only those officially seeking work and exclude anyone who made no attempt to find work in the previous 4-week period. Some Alaskan economists believe that Alaska's rural communities have a large percentage of "discouraged workers"; that is, those who are involuntarily unemployed and not counted in the USDOL/BLS data (Windisch-Cole, 1996, pers. comm.). According to data collected for the 1993 NSB Census of Population and Economy, the unemployment rate was 11 percent, and the portion of the labor force that worked <40 weeks in the previous year was 22 percent. The latter figure does not include employees of the NSB School District. Also according to the 1993 NSB census, 24 percent of the Borough's resident labor force believes itself to be underemployed (NSB, 1995). Other Alaska economists do not think that the discouraged-worker hypothesis applies to the NSB. In a mixed cash-subsistence economy, people who do not have cash jobs for part of the year may not take one if offered (Berman, 1997, pers. comm.).

The employed labor force consists of 59 percent Inupiat, 28 percent Caucasian, and 13 percent other minorities. Of the entire Borough-wide resident labor force, including both employed and unemployed, 16% are unemployed Inupiat, 2.5% are unemployed Caucasian, and 7.5% are unemployed other minorities (NSB, 1995).

A primary goal of the NSB has been to create employment opportunities for Native residents, and they have been successful in hiring large numbers of Natives for NSB construction projects and operations. Only a small number of permanent residents hold jobs at the industrial enclaves at Prudhoe Bay. Residents seem to prefer the employment created by the NSB to jobs potentially available in industry. Pay scales offered by the NSB are equal to or better than those in the oil and gas industry, and the working conditions and flexibility offered by the NSB are considered by the Natives to be superior to those prevailing in the oil and gas industry. The NSB employment has been both high-paying and very flexible compared to standards prevailing in other parts of the State, permitting employees to take time off, particularly for subsistence hunting.

Very few North Slope Natives have been employed in the oil-production facilities and associated work in and near Prudhoe Bay since production started in the late 1970's. Also, North Slope Natives are not motivated to move because of employment. This historical information is relevant to assessing the potential economic effects of proposed oil and gas exploration and development on the North Slope Native population. A study contracted by MMS shows that 34 North Slope Natives interviewed comprised half of all North Slope Natives who worked at Prudhoe Bay in 1992, and that the North Slope Natives employed at Prudhoe Bay comprised <1 percent of the 6,000 North Slope oil-industry workers (USDOI, MMS, 1993).

c. Subsistence as a Part of the NSB Economy: Subsistence hunting is a noncash portion of the NSB economy and is an important part of the whole economy. Subsistence is an even more important part of the culture (see Secs. III.C.3 and III.C.4).

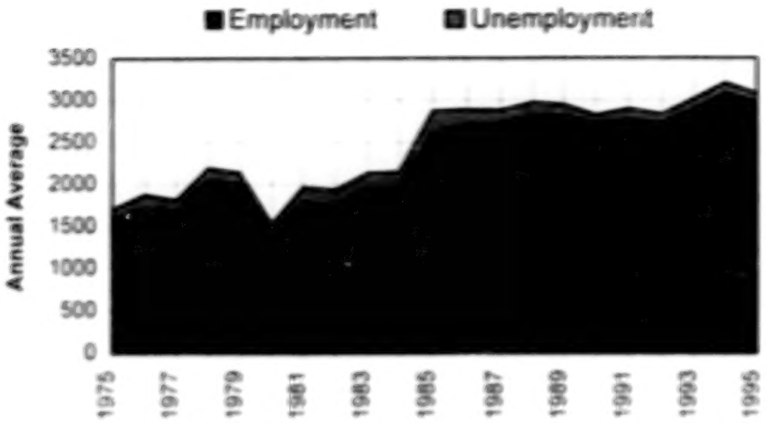


Figure III.C.1-1. North Slope Borough Labor Force, 1975–1995: Workers Residing Permanently in the North Slope Borough. Source: U.S. Department of Labor, Bureau of Labor Statistics, "Historical Report on Labor Force and Employment," provided by ADOL.

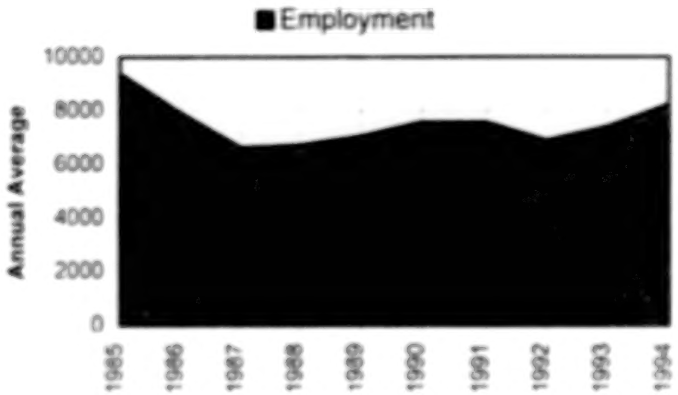


Figure III.C.1-2. North Slope Borough Nonagricultural Employment, 1985–1995: Workers Working in the North Slope Borough. Source: Nonagricultural Wage and Salary Employment and Earnings by Census Area, 1985–1990; Employment and Earnings Summary Reports, 1991–1994.

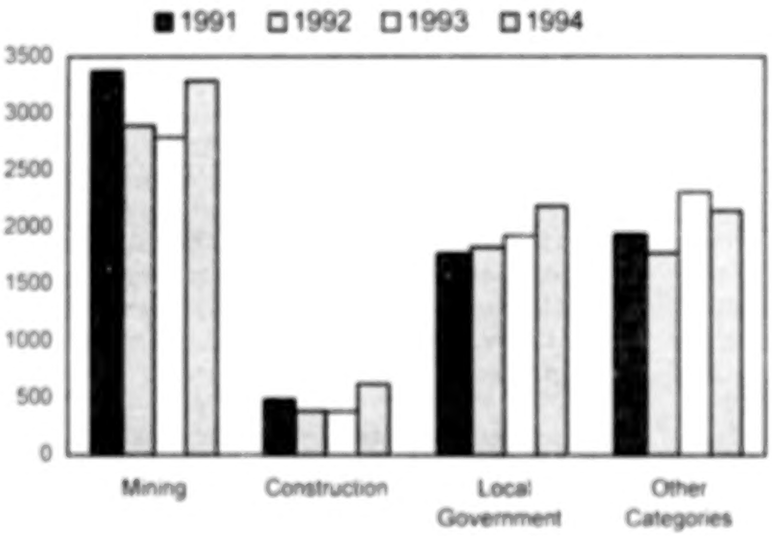


Figure III.C.1-3. North Slope Borough Nonagricultural Employment by Selected Industry Type, 1991–1994. Source: Employment and Earnings Summary Report, 1991–1994, ADOL.

d. State Revenues: State property tax revenues, royalty income, and severance tax revenues associated with the NPR-A have been zero in recent years.

The Federal Government must distribute 50 percent of all revenues from "sales, rentals, bonuses, and royalties" on oil and gas leases within the NPR-A tothe State of Alaska. The 50-percent distribution is not applicable to state taxes such as severance, property, and conservation taxes. Federal law requires the State to give priority to the municipalities most affected by oil and gas developments (42 U.S.C. § 6508).

In allocating NPR-A revenues received from the federal government under 42 U.S.C. § 6508, the state must give priority to municipalities most directly or severely impacted by oil and gas activities in the NPR-A. This is accomplished through a grant program. Funds are generally received twice a year and are available for grants during the following fiscal year. Revenues are placed in the NPR-A Special Revenue Fund when received from the federal government (Alaska Statutes [AS] 37.05.530). Funds not issued as grants to municipalities by the end of each fiscal year are distributed in the following manner: 50 percent to the Permanent Fund, 0.5 percent to the Public School Fund, and 49.5 percent to the General Fund.

The Alaska Department of Community and Regional Affairs administers the grant program (19 Alaska Administrative Code [AAC] 50). The purpose of the grants is to provide mitigation for significant adverse impacts related to oil and gas leasing within the NPR-A. Municipalities may apply for grants each year for the purposes of planning, construction, and maintenance of essential public facilities, or for provision of other necessary public services. Municipalities must demonstrate the present impact or foreseeable future impact from oil and gas exploration, production, or transportation. Grants must meet certain eligibility requirements (19 AAC 50.050). There is currently no money in the NPR-A Special Revenue Fund available for grants. Additional funds will not be placed in the fund until a new oil and gas lease sale is held in the NPR-A.

e. Southcentral Alaska Employment: Employment in Southcentral Alaska associated with the NPR-A in recent years is assumed to be zero. There has been very little employment with relevant government agencies, recreation, and scientific research. However, for the purpose of this analysis, it is assumed to be zero. The population in Southcentral Alaska in 1995 was 356,000. The 1995 population for the three local governments of Southcentral are: Anchorage, 258,000; Matanuska-Susitna Borough, 51,000; and Kenai Peninsula Borough, 47,000 (State of Alaska, DCRA, 1996).

f. Recreation Employment: Recreation employment is generated by 14 float trip parties per year (Table II.H.3.b). These parties are estimated to be 1 week each and generate employment equal to one person for 4 months each year.

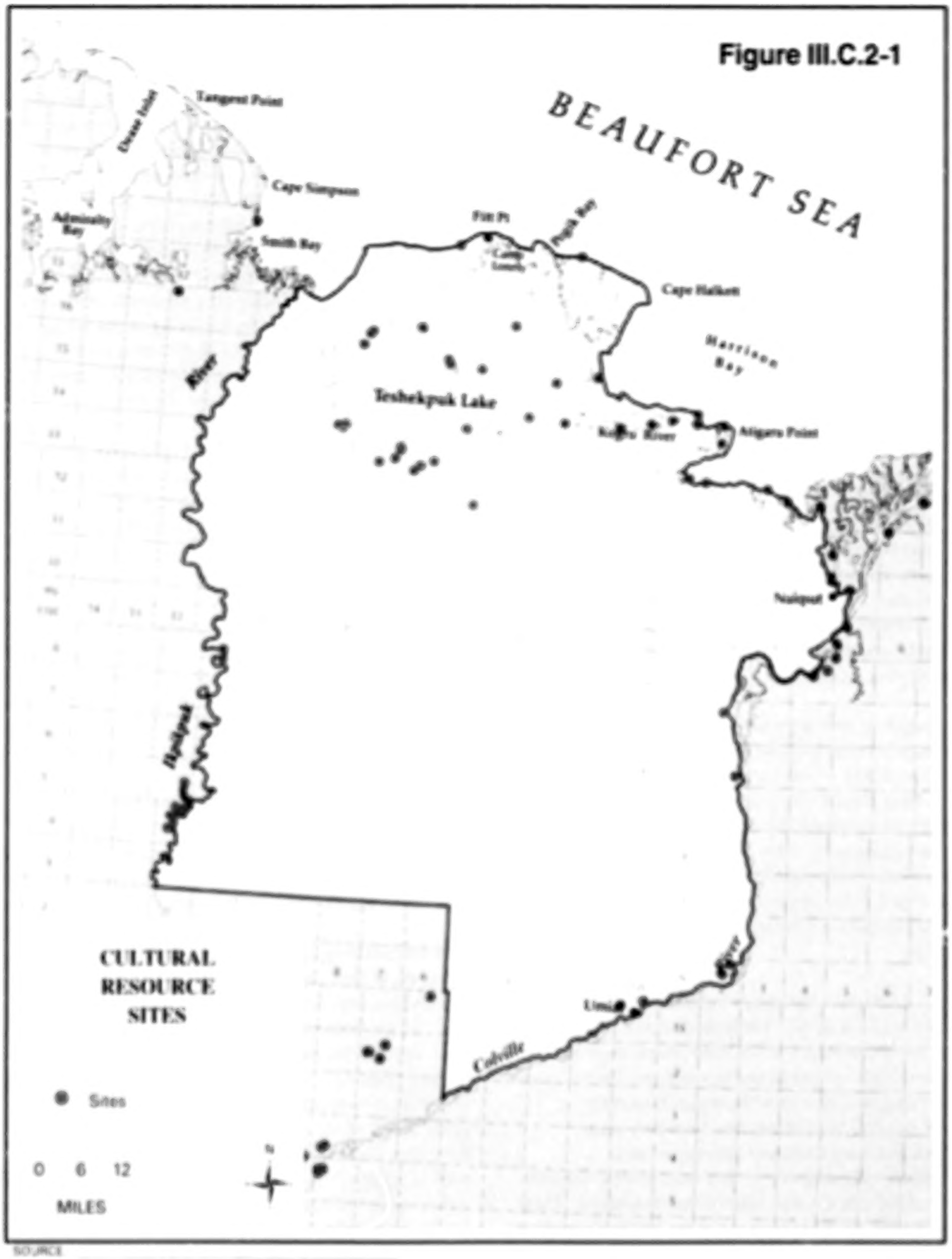
2. Cultural Resources: In terms of the peopling of the New World, the NPR-A is located on the threshold of the gateway to North America. There is little doubt that the first human to set foot in the Western Hemisphere left that first footprint in Alaska. It was over the Bering Land Bridge, the dry-land connection between Asia and North America, that the first humans entered the New World, beginning an odyssey that would traverse almost 12,000 mi and populate two continents. In terms of the beginning of New World culture history, there is no locale in the Western Hemisphere that is more historically significant than Alaska's North Slope (Kunz and Reanier, 1994, 1995).

Sixty miles southeast of the planning area along the southern boundary of the NPR-A, evidence from the 12,000-year-old Mesa archaeological site, a hunting lookout used by Ice-Age big-game hunters, has caused the international archaeological community to rethink theories regarding the migration of humans to the New World and their subsequent cultural evolution. By consensus of the international scientific community, the Mesa site is considered one of the most important archaeological sites in the Western Hemisphere (Kunz and Reanier, 1994, 1995).

Two-hundred miles north of the Mesa, on the arctic coast at Point Barrow, 65 mi northeast of the planning area, lies the Utqiagvik site, a village occupied 500 years ago by the whale-hunting Thule people. Although more than 11,000 years younger than the Mesa site, Utqiagvik certainly is as well known, and its cultural significance bears directly on today's North Slope residents. Utqiagvik was the home of people who had practically refined whaling to an art form, making whales a reliable subsistence resource that changed lifeways that probably had remained static for thousands of years. Five-hundred years later, the archaeological excavation of that village revealed the "Frozen Family," yielding unmatched information concerning the material culture, architecture, and pathology of the ancient residents and, in the process, strengthened the ethnic tie between those Stone-Age whale-hunters and their Computer-Age descendants, the modern Inupiat Eskimos (Hall and Fullerton, 1988).

Some of the earliest history of northern Alaska played out in this region when contact between the Euro-American arctic whaling fleet and Alaskan Natives first occurred at the midpoint of the 19th century. What followed was more than 50 years of continuous contact that drastically altered

Figure III.C.2-1



SOURCE:

BEST COPY AVAILABLE

201

a traditional culture and set in motion a massive alteration of Native Alaskan lifestyle (Brower, 1942; Foote, 1964; Bockstoce, 1978). In just a few generations, the indigenous people of the North Slope moved directly from the Stone Age to the Atomic Age.

The physical remains of at least 12,000 years of human occupation reside within the NPR-A, and it may be the only place where the culture history of our half of the globe can be traced from its first day to the present. The region initially was occupied by immigrants from Asia who probably were deterred from moving south and held for a while in the Alaskan Arctic because of the mass of glacial ice that isolated Alaska from the rest of the continent (Kunz, 1996). At about the same time, however, a second distinct cultural group that archaeologists refer to as North American Paleoindians also were present. The Paleoindians are thought to have evolved from the mix of Old World cultures contained in the Beringian holding pen and are considered by most scholars to represent the first indigenous North American culture (Kunz and Reanier, 1995). About 9,500 years ago—as today's modern climate and vegetational regime emerged from the Ice Age, the land bridge was inundated, and the arctic coast reestablished—the physical evidence for cultural distinction between the Paleoindians and the Old World Asian cultures seems to blur in the archaeological record. Probably due to a continuing influx of people across the Bering Strait into Alaska, the material culture traits of the Old World seem to predominate in the North Slope's archaeological assemblages.

The Ice-Age cultures were followed by a group referred to generically by archaeologists as Northern Archaic Peoples (Anderson, 1968). These cultural groups inhabited the NPR-A from about 8,500 years ago to 4,500 years ago. Although the mammoth, bison, and horse of Paleoindian times had disappeared, these people continued to inhabit and exploit the resources of the region in much the same way as their Ice-Age predecessors by hunting large terrestrial mammals, the emerging populations of caribou and moose.

Roughly 5,000 years ago, a new cultural entity appeared in the NPR-A—the Eskimo. While the Eskimo were not among the first to reside on the North Slope, their more varied and sophisticated technology allowed them to more fully exploit the resources of the region than their predecessors had been able to do. Soon they were dominant and more numerous than any of their predecessors. Because of this, they were great colonizers and expanded into Canada, Siberia, and Greenland. There is an unbroken record of their use of the North Slope since they first appeared on the scene (Reanier, 1997; Sheehan, 1997).

The succession of the Eskimo Continuum cultures began with the Denbigh Flint Complex people, who were followed by the Norton and Ipiutak cultures. These three closely related cultural groups together make up what archaeologists refer to as the Arctic Small Tool tradition (Irving, 1964). These early Eskimos spent as much or more time living in and exploiting the subsistence resources of the foothills and mountains of the Brooks Range as they did the coast. About 1,600 years ago, the emphasis switched to the coast with the Birnirk people, who developed technology that allowed them to successfully exploit maritime resources (Stanford, 1976). They in turn were followed by the previously mentioned Thule people. At the same time, related but less numerous populations continued to exploit the resources of the interior, primarily subsisting on caribou and other large terrestrial mammals and overwintering on the margins of lakes that contained plentiful fish resources (Gerlach and Hall, 1988). These people may have been the antecedents of the modern Nunamiut or Inland Eskimo.

It is worth particular note that only rarely does a single cultural group hold sway over a region as large as the North Slope for such an extended period of time. The modern indigenous population of the NPR-A is as successful today, subsisting in one of the harshest environments on the planet, as were their ancestors of 5,000 years ago. The hard evidence that supports this story, the material culture of the North Slope, resides in thousands of archaeological sites distributed throughout the region. These sites contain the physical manifestation of the culture history of the NPR-A, a nonrenewable resource. This resource must be protected and managed wisely for both its scientific and cultural value.

To date, >1,200 prehistoric and historic sites have been located in the 2 to 3 percent of the NPR-A that has been examined for the presence of cultural sites. These sites range in age from 12,000 years ago through the turn of the 20th centurey (Reanier, 1997; Sheehan, 1997).

Given this history of 12,000 years of continuous human presence, at first glance it seems odd that <100 prehistoric and historic sites have been reported from the planning area. When looking at the site plot-map of the region, it is quite evident that most of the sites are clustered in a few locales. This does not reflect distributional density based on the locational preference of prehistoric people, but rather the fact that only a few portions of the planning area have been examined for the presence of cultural sites. The total absence of recorded cultural sites across most of the planning area is simply the result of the limited work that has been conducted there. Where inventories and surveys have been conducted, cultural sites usually have been found. This suggests that examination of the unsurveyed portions of the planning area dramatically would increase the number of known sites.

The North Slope Borough's Traditional Land Use Inventory (TLUI) is a compilation of subsistence resource/use locations, landmarks, travel routes, and special significance locales that exist in the living memory of tribal elders. The number of TLUI locales in the planning area greatly exceeds the number of recorded archaeological sites, suggesting that if cultural memory is a reliable manifestation of reality, there must be hundreds of as-yet-undiscovered cultural sites within the planning area.

Most of the cultural sites in the NPR-A are, by virtue of their isolation and remoteness, protected from most types of impact other than those caused by natural forces. The vast majority of the prehistoric sites are partially exposed or at most shallowly buried and, therefore, vulnerable to impacts generated by human activity. Historic sites, almost without exception, lie on the surface and are extremely susceptible to impacts. Although most surface impacting activities take place during the winter when snow covers the deeply frozen ground, damage to or destruction of cultural sites can occur. For this reason, foreknowledge of planned surface-disturbing activities, whether planned to occur in winter or summer, is essential if these resources are to be protected as directed by law, Executive Order, and policy.

3. Subsistence: This section describes the subsistence-harvest patterns of the Inupiat (Eskimo) communities adjacent to the planning area: Barrow, Atqasuk, and Nuiqsut. This community-by-community description provides general information on subsistence-harvest patterns, harvest information by resource and community, timing of the subsistence-harvest cycles, and harvest-area concentrations by resource and by community. Subsistence-harvest patterns of these communities recently have been described in Section III.C.3 of the Beaufort Sea Sale 124 FEIS (USDOI, MMS, 1990) and the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a) and are herein incorporated by reference. The following description is augmented by information from current studies including ADF&G (1996); Alaska Natives Commission (1994); City of Nuiqsut (1995); and USDOI, MMS (1996b,c); as well as Hoffman, Libbey, and Spearman (1988); North Slope Borough Contract Staff (1979); Impact Assessment (1990a,b); Hall (1983); USDOI, MMS (1997); and the following USDOI, BLM NPR-A 105(c) and other pertinent documents: USDOI, BLM (1978a,b,c; 1979a,b,c,d; 1981; 1982a,b,c; 1983a,b,c; 1990; 1991; and 1997).

The community residents adjacent to the planning area participate in a subsistence way of life. While new elements have been added to the way people live, this way of life is a continuation of centuries-old Inupiat traditional patterns. Until January 1990, Alaska Statutes defined "subsistence uses" as "the non-commercial, customary and traditional uses of wild, renewable resources by a resident domiciled in a rural area of the state for personal or family consumption" (AS 16.05.940); and subsistence uses were given priority over other uses. In January 1990, as a result of *McDowell v. State of Alaska*, this law was declared unconstitutional by the Alaska Supreme Court. However, Federal law (Title VIII of the Alaska National Interest Lands Conservation Act [ANILCA]) continues to define Alaskan subsistence, as Federal law may define Alaskan subsistence and grant it a priority, but only on Federal public lands. The new ruling means Alaska legally cannot (according to State law) establish rural preference for subsistence. The effect of the Alaska Supreme Court's decision was stayed until July 1, 1990. The State had until then to devise a solution to the issues raised in the *McDowell* decision. The Alaska State Legislature was not able to pass any subsistence legislation despite a special session called for that purpose. On Federal lands in Alaska, Federal laws grant subsistence priority over other uses, and Federal Agencies now are managing these hunts and will continue to do so until State legislation can be enacted (USDOI, FWS, 1992). Spurred by a number of recent court decisions and the State of Alaska's failure to enact a subsistence plan that guarantees some type of rural preference, a plan for managing subsistence fisheries on Federal lands is being developed by the FWS.

Subsistence activities, which are assigned the highest cultural values by the Inupiat, provide a sense of identity as well as an important economic activity. The importance of subsistence harvests to the maintenance of cultural identity has grown as social pressures associated with development build.

Inupiat concerns regarding oil development for the NPR-A that were identified during scoping, and those identified in public outreach for recent OCS actions and the Northstar project, can be divided into eight categories: (1) disruption of migrating subsistence species; (2) direct damage to subsistence resources and habitats; (3) disruption of access to subsistence areas; (4) loss of Native food; (5) degradation of traditional Inupiaq places; (6) concern over cumulative oil- development impacts (especially in the community of Nuiqsut); (7) insufficient recognition of Inupiat indigenous knowledge concerning subsistence resources, subsistence-harvest areas, and subsistence practices; and (8) damage to Inupiaq culture. One analysis of Inupiat concerns about oil development was based on a compilation of approximately 10 years of recorded testimony at North Slope public hearings for State and Federal energy-development projects. The majority of concerns centered on the subsistence use of resources, including damage to subsistence species, loss of access to subsistence areas, loss of Native foods, and interruption of subsistence-species migration. These four concerns represent the concerns expressed in 83 percent of all the testimony taken on the North Slope (Stephen R. Braund and Associates, In prep., Kruse et al., 1983:Table 16; Human Relations Area Files, Inc., 1992; USDOI, MMS, 1994).

Many species are important for the role they play in the annual cycle of subsistence-resource harvests, yet effects on subsistence could be serious even if the net quantity of available food did not decline. The consumption of harvestable subsistence resources provides more than dietary benefits; these resources also provide materials for personal and family use, and the sharing of harvestable subsistence resources helps maintain traditional Inupiat family organization. Subsistence resources provide special foods for religious and social occasions such as Christmas, Thanksgiving, and—the most important ceremony in the communities adjacent to the planning area—Nalukataq, which celebrates the bowhead whale harvest. The sharing, trading, and bartering of harvestable subsistence resources structures relationships among communities adjacent to the planning area, while the giving of such foods helps maintain ties with family members elsewhere in Alaska. Additionally, subsistence provides a link to the cash economy; many households within the communities earn cash from crafting whale baleen and walrus ivory and from harvesting furbearing mammals. Also, full-time wage employment has affected the subsistence hunt by, on the one hand, providing cash for snowmachines, boats, motors and fuel. On the other hand, full-time employment limits the time a subsistence hunter is able to spend hunting to after work hours. During midwinter, this is further limited by waning daylight. In summer, extensive hunting and fishing activities can be pursued after work because of the long days.

a. Annual Cycle of Harvest Activities: The primary subsistence-harvest areas for Barrow, Atqasuk, and Nuiqsut are shown in Figures III.C.3-1, Lifetime Community Subsistence Land Use Area Boundaries. Very few Inupiat live outside of the traditional communities, but the seasonal movement to hunting sites and camps for subsistence activities involves the travel over and use of extensive areas around these settlements. Figure III.C.3-1 shows the aggregate community subsistence-harvest areas for the primary subsistence resources of marine mammals (whales, seals, walruses, polar bears), caribou, fish, birds (and eggs), furbearers (for hunting and trapping), moose, Dall sheep, grizzly bear, small mammals, and invertebrates, as well as berries, edible roots, and fuel and structural material. Specific harvest areas for wildfowl, caribou, moose, fish, and whales for Barrow, Atqasuk, Nuiqsut, and Anaktuvuk Pass are shown in Figures III.C.3-2, -6, -10, and -14, respectively. Annual subsistence cycles for Barrow, Atqasuk, and Nuiqsut are described below and are shown in Figures III.C.3-3, -7, and -11.

b. Community Subsistence-Harvest Patterns: This section provides general information regarding subsistence-harvest patterns in all of the communities close to the planning area. Two subsistence-resource niches occur on the North Slope: the coastal marine and the terrestrial aquatic. In the coastal marine niche, the same basic food resources are harvested: whales, seals, walruses, waterfowl, and fish. In the terrestrial/aquatic niche, resources would be caribou, freshwater fish, moose, Dall sheep, grizzly bears, edible roots and berries, and furbearers. Generally, communities harvest those resources most available to them, but harvest activities may occur anywhere in the planning area. Subsistence harvests tend to be concentrated near communities, along rivers and coastlines, and at particularly productive sites. The distribution, migration, and the seasonal and more extended cyclical variation of animal populations makes determining what, where, and when a subsistence resource will be harvested a complex activity. Many areas might be used infrequently, but they can be quite important harvest areas when they are used (USDOI, BLM, 1978c).

Use by a village of any particular species can vary greatly over time, and data from short-term harvest surveys often can lead to a misinterpretation of use/harvest trends. For example, if a particular village did not harvest any bowhead whales in one year, clearly their use of whales would go down but, consequently, their use of caribou and other species likely would go up—in absolute and percent terms. If caribou are not available in one winter, other terrestrial species could be hunted with greater intensity.

The subsistence areas and activities of all three communities near the planning area could be affected by the proposed NPR-A IAP, and portions of the terrestrial subsistence-harvest areas of Barrow, Atqasuk, and Nuiqsut lie within or near the planning area.

The subsistence harvest of vegetation by communities adjacent to the planning area is limited, while the harvest of faunal resources such as marine and terrestrial mammals and fishes is heavily emphasized. The spectrum of available resources in this region is limited when compared with more southerly regions. Subsistence resources used by these communities are listed in Table III.C.3-1 by common species name, Inupiaq name, and scientific name. For a comparison of the proportion of Inupiaq household foods obtained from subsistence in the years 1977, 1988, and 1993, see Table III.C.3-2 (see also the Beaufort Sea Sale 144 FEIS, Sec. III.C.3 [USDOI, MMS, 1996a]). Table III.C.3-3 shows the percentage of households that participated in successful harvests of subsistence resources in the three communities being discussed, and Table

BLANK PAGE

Table III.C.3-1
Resources Used in Barrow, Kaktovik, and Nuiqsut

Species	Inupiaq Name	Scientific Name	Location		
			B[1]	A[2]	N[3]
	Marine Mammals				
Bearded seal	Ugruk	Erignathus barbatus	✓		✓
Ringed seal	Natchiq	Phoca hispida	✓		✓
Spotted seal	Qasigiaq	Phoca largha	✓		✓
Ribbon seal	Qaigulik	Phoca fasciata	✓		
Belukha whale	Qilalugaq	Delphinapterus leucas	✓		✓
Bowhead whale	Agviq	Balaena mysticetus	✓		✓
Polar bear	Nanuq	Ursus maritimus	✓		✓
Walrus	Aiviq	Odobenus rosmarus	✓		✓
	Terrestrial Mammals				
Caribou	Tuttu	Rangifer tarandus	✓	✓	✓
Moose	Tuttuvak	Alces alces	✓	✓	✓
Brown bear	Aklaq	Ursus arctos	✓	✓	✓
Dall sheep	Imnaiq	Ovis dalli	✓		✓
Musk ox	Umimmaq	Ovibos moschatus			✓
Arctic fox (blue)	Tigiganniaq	Alopex lagopus	✓	✓	✓
Red fox (cross, silver)	Kayuqtuq	Vulpes fulva	✓	✓	✓
Porcupine	Qinagluk	Erethizon dorsatum	✓		
Ground squirrel	Siksrik	Spermophilus parryii	✓	✓	✓
Wolverine	Qavvik	Gulo gulo	✓	✓	✓
Weasel	Itigiaq	Mustela erminea			✓
Wolf	Amaguk	Canis lupus	✓	✓	✓
Marmot	Siksrikpak	Marmota broweri			✓
	Fish				
Salmon (ns)					
Chum	Iqalugruaq	Oncorhynchus keta	✓	✓	✓
Pink (humpback)	Amaqtuuq	Oncorhynchus gorbuscha	✓	✓	✓
Silver (coho)	Iqalugruaq	Oncorhynchus kisutch		✓[4]	
King (chinook)		Oncorhynchus tshawytscha			
Sockeye (red)		Oncorhynchus nerka			
Whitefish (ns)	Aanaakliq	Coregonus sp	✓	✓	
Round w.f.	Aanaakliq	Prosopium cylindraceum	✓	✓	
Broad w.f.	Aanaakliq	Coregonus nasus	✓	✓	✓
Humpback w.f.	Pikuktuuq	Coregonus clupeaformis	✓		✓
Least cisco	Iqalusaaq	Coregonus sardinella	✓	✓	✓
Bering Arctic cisco	Qaaktaq	Coregonus autumnalis	✓	✓	✓
Other f.w. fish					
Arctic grayling	Sulukpaugaq	Thymallus arcticus	✓	✓	✓
Arctic char	Iqalukpik	Salvelinus alpinus	✓	✓	✓
Burbot (ling cod)	Tittaaliq	Lota lota	✓	✓	✓
Lake trout	Iqaluaqpak	Salvelinus namaycush	✓	✓	✓
Northern pike	Siulik	Esox lucius	✓		
	Fish (continued)				
Other coast. fish					
Capelin	Pagmaksraq	Mallotus villosus	✓		
Rainbow smelt	Ithuagniq	Osmerus mordax	✓		✓
Arctic cod	Iqalugaq	Boreogadus saida	✓		✓
Tomcod	Uugaq	Eleginus gracilis	✓		
Flounder (ns)	Nataagnaq	Liopsetta glacialis			
	Birds				
Snowy owl	Ukpik	Nyctea scandiaca			✓
Red-throated loon	Qaqsraupiagruk	Gavia stellata	✓		
Tundra swan	Qugruk	Cygnus columbianus		✓	✓
Eider					
Common eider	Amauligruaq	Somateria mollissima	✓	✓	✓
King eider	Qinalik	Somateria spectabilis	✓	✓	✓
Spectacled eider	Tuutalluk	Somateria fischeri	✓		
Steller's eider	Igniqauqtuq	Polysticta stelleri	✓		
Other ducks (ns)	Qaugak		✓	✓	✓
Pintail	Kurugaq	Anas acuta		✓	✓
Oldsquaw	Aaqhaaliq	Clangula hyemalis	✓	✓	✓
Surf scoter	Aviluktuq	Melanitta perspicillata	✓		
Goose					
Brant	Niglingaq	Branta bernicla n	✓	✓	✓
White-fronted g	Nigliviatuk	Anser albifrons	✓	✓	✓
Snow goose	Kanuq	Chen caerulescens	✓	✓	✓
Canada goose	Iqsragutilik	Branta canadensis	✓	✓	✓
Ptarmigan (ns)	Aqargiq	Lagopus sp	✓	✓	✓
Willow ptarmigan	Nasaulik	Lagopus lagopus	✓	✓	
	Other resources				
Berries (ns)			✓	✓	✓
Blueberry	Asiaq	Vaccinium uliginosum	✓	✓	
Cranberry	Kimmingnaq	Vaccinium vitis-idaea	✓	✓	
Salmonberry	Aqpik	Rubus spectabilis	✓	✓	
Bird eggs (ns)	Mannik		✓	✓	✓
Gull eggs					✓
Goose eggs				✓	✓
Eider eggs			✓	✓	✓
Greens/roots (ns)			✓	✓	✓
Wild rhubarb	Qunulliq	Oxyria digyna	✓	✓	
Wild chives	Quagaq	Allium schoenoprasum	✓	✓	
Other					
Clams	Imaniq		✓		
Wood				✓	✓
Freshwater	Imiq		✓		
Freshwater ice	Sikuliaq		✓		
Sea ice	Siku		✓		

Sources: Stephen R. Braund and Associates and UAA, ISER, 1993; Pedersen, 1995a, 1995b; Stephen R. Braund and Associates, 1996; Schneider, Pedersen, and Libby, 1980; ACI, Courtnage, and Braund, 1984; Brower and Opie, 1997; Opie, Brower, and Bates, 1997.

[1] B. Barrow. Resources used 1987–1990.

[2] A. Atqasuk. Atqasuk residents use marine mammals and hunt on Barrow whaling crews.

[3] N. Nuiqsut. Resources used 1993.

[4] Harvest of silver, king, and sockeye salmon rare.

Note: An unchecked box may mean a resource was not used or, especially in the case of "Other Resources," the resource might have been used but use was reported as "berries" rather than "blueberries," for example.

Abbreviations: ns, nonspecified; w.f., whitefish; f.w., freshwater; coast., coastal.

205

Table III.C.3-2
Proportion of Inupiat Household Food Obtained from Subsistence Activities, 1977, 1988, and 1993 (proportion is measured in percent)

Proportion	1977	1988	1993
All Communities of the North Slope Borough			
None	13	20	18
Less Than Half	42	31	25
Half	15	14	15
More Than Half	30	35	42
North Slope Excluding Barrow			
None	16	14	13
Less Than Half	35	31	26
Half	12	14	15
More Than Half	37	28	46
Barrow Only			
None	11	26	25
Less Than Half	49	32	24
Half	18	15	13
More Than Half	23	29	38

Source: Harcharek, 1995.

Table III.C.3-4
Individual Subsistence Resource Percentages of Average Total Community Annual Subsistence Harvest

	Barrow (%)		Atqasuk (%)	Nuiqsut (%)	
Resource	1962-82[1]	1989-90	1994-95	1993	1994-95
Bowhead Whale	21.3	37.7	—	28.7	0
Caribou	58.2	28.6	57	30.6	48
Walrus	4.6	9.0	—	0	—
Bearded Seal	2.9	4.4	2[2]	0.3	—
Hair Seal	4.3	2.4	—	2.7	3
Beluka Whale	0.5	0.0	—	0	—
Polar Bear	0.3	1.5	—	0	—
Moose	0.3	3.4	—	1.6	21
Dall Sheep	0	—	—	0	—
Muskox	—	—	—	0	—
Small Land Mammals	0.1	**	—[3]	**	**
Birds[4]	0.9	3.5	3	1.5	4
Fish	6.6	11.3	37	33.7	25
Vegetation	—	—	1	1.4	**
Total Harvest (lb)	626,205	782,660	—[5]	267,818	—[5]
Per Capita Harvest (lb)	540	233.10	—	741.75	—

Sources: Stoker, 1983, as cited by ACI/Braund, 1984; Stephen R. Braund & Associates, 1989b; ADF&G, 1995b; Brower and Opie, 1997a,b, for Atqasuk; Opie, Brower, and Bates, 1997.

[1] Averaged for the period. [2] Ringed and bearded seals provided 2%. [3] Not harvested for food. [4] Birds and eggs. [5] Not calculated in report.

** Represents less than 0.1 percent.

Table III.C.3-3
Participation in Successful Harvests of Selected Resources in Barrow and Nuiqsut (percentage of households per resource)

	Barrow[1]	Nuiqsut[2]
Total	87%	90%
Marine Mammals	76	37
Terrestrial Mammals	77	78
Fish	60	81
Birds	65	76
Marine mammals		
Bowhead Whale	75%	5%
Walrus	29	0
Bearded Seal	46	7
Ringed Seal	19	31
Spotted Seal	1	2
Polar Bear	7	2
Terrestrial mammals		
Caribou	77%	74%
Moose	7	10
Brown Bear	0	8
Dall Sheep	3	0
Wolverine	1	16
Arctic Fox	5	13
Red Fox	*	23
Fish		
Whitefish (all species)	54%	74%
Grayling	21	65
Arctic Char	5	31
Salmon (all species)	16	36
Burbot	10	57
Birds		
Geese	40%	73%
Eiders	52	36
Ptarmigan	26	45

All numbers are percentages.
Sources: Stephen R. Braund and Assoc. and UAA ISER, 1993; Pedersen, 1995a, 1995b; Stephen R. Braund and Assoc., 1996.
Dates resources used: [1] 1987-1990. [2] 1992-1993. * Represents less than 0.1%.

III.C.3-4 shows individual species percentages of the total average subsistence harvest for each community.

While subsistence-resource harvests differ from community to community, the resource combination of caribou, bowhead whales, and fishes was identified as being the primary grouping of resources harvested (Table III.C.3-4). Caribou is the most important overall subsistence resource in terms of effort spent hunting, quantity of meat harvested, and quantity of meat consumed (effort spent hunting is measured by frequency of hunting trips rather than total kilograms harvested). The bowhead whale is the preferred meat and the subsistence resource of primary importance, because it provides a unique and powerful cultural basis for sharing and community cooperation (Stoker, 1984, as cited by Anchorage Consultants, Inc. [ACI], Courtnage, and Braund, 1984); in fact, the bowhead could be said to be the foundation of the sociocultural system. Depending on the community, fish is the second or third most important resource after caribou and the bowhead whale (Table III.C.3-4). Bearded seals and various types of birds also are considered primary subsistence species. Waterfowl are particularly important during the spring, when they provide variety to the subsistence diet. In the late 1970's, when bowhead whale quotas were low and the Western Arctic Caribou herd crashed (and the Alaska Board of Game placed bag limits on them), hunters turned to bearded seals (ugruk), ducks, geese, and fish to supplant the subsistence diet; Atqasuk could only turn to the last three resources (Schneider, Pedersen, and Libbey, 1980). Seal oil from hair and bearded seals is an important staple and a necessary complement to other subsistence foods.

The subsistence pursuit of bowhead whales is a major concern to the communities of Barrow and Nuiqsut (some Atqasuk men whale with Barrow crews, and the sharing of whale muktuk and meat is important to this inland community), and continues today to be the most valued activity in the subsistence economy of these communities. This is true even in light of harvest constraints by imposed quotas of the International Whaling Commission (IWC); relatively plentiful supplies of other resources such as caribou, fish, and other subsistence foods; and supplies of retail grocery foods. Whaling traditions include kinship-based crews, use of skin boats (only in Barrow for their spring whaling season), shoreline preparation for distribution of the meat, and total community participation and sharing. In spite of the rising cash income, these traditions remain as central values and activities for all the Inupiat in these North Slope communities. Bowhead whaling strengthens family and community ties and the sense of a common Inupiaq heritage, culture, and way of life. In this way, whaling activities provide strength, purpose, and unity in the face of rapid change. Barrow is the only community within the area that harvests whales in both the spring and the fall. Nuiqsut residents hunt bowheads only during the fall season.

Some older harvest data for Barrow are only estimates that represent average values. Because of this limitation, these resource-harvest data are presented in terms of a 20-year average (from 1962-1982); for Atqasuk, there is only the recent 1994-to-1995 subsistence survey conducted by the NSB (Table III.C.3-4). Table III.C.3-4, showing the contribution made by various harvestable subsistence resources to the Native diet, is based on the amount of usable meat and fat contributed to the diet rather than on the number of animals harvested. The 20-year averages do not reflect the important shift in subsistence-harvest patterns that occurred in the late 1960's, when the substitution of snowmachines for dogsleds decreased the importance of ringed seals and walruses (two key dogfoods) and increased the relative importance of waterfowl in the subsistence system. This shift illustrates that technological or social change may lead to long-term modifications of subsistence practices. Because of changes in technology and in the subsistence-harvest patterns mentioned above, the dietary importance of waterfowl also may continue to increase; however, none of these changes would affect the central and specialized dietary roles that bowhead whales, caribou, and fish—the three most important subsistence-food resources—play in the subsistence harvests of Alaska's North Slope Inupiat, and for which there are no viable substitutes.

(1) **Barrow**: As with other communities adjacent to the planning area, Barrow residents (population 3,469 in 1990 and 4,234 in 1995 [USDOC, Bureau of the Census, 1991; ADOL figures as cited in ADF&G, 1995b]) enjoy a diverse resource base that includes both marine and terrestrial animals. Barrow's location is unique among the communities in the sale area: the community is a few miles southwest of Point Barrow, the demarcation point between the Chukchi and Beaufort seas. This location offers superb opportunities for hunting a diversity of marine and terrestrial mammals and fishes. Barrow's subsistence-harvest area can be seen in Figure III.C.3-1. Subsistence resources used by Barrow are listed in Table III.C.3-1 by common species name, Inupiaq name, and scientific name. Specific subsistence-harvest areas for major subsistence resources for Barrow are shown in Figure III.C.3-2.

(a) **Bowhead Whales**: Unlike residents of Nuiqsut, Barrow residents hunt the bowhead whale during both spring and fall; however, more whales are harvested during the spring whale hunt, which is the major whaling season (Fig. III.C.3-3). In 1977, the IWC established an overall quota for subsistence hunting of the bowhead whale by the Alaskan Inupiat. The quota currently is regulated by the Alaska Eskimo Whaling Commission (AEWC), which annually decides how many bowheads each whaling community may take. Barrow whalers continue to hunt in the fall to meet their quota and to seek strikes that can be transferred to the community from other villages from the previous spring hunt. There are approximately 30 whaling camps along the edge of the landfast ice. The locations of these camps depend on ice conditions and currents; normally, strong currents and many leads near Point Barrow prohibit crews from camping near the actual point. Most whaling camps are located south of Barrow, some as far south as Walakpa Bay.

Depending on the season, the bowhead is hunted in two different areas. In the spring (from early April until the first week of June), the bowheads are hunted from leads that open when pack-ice conditions deteriorate. At this time, bowhead whales are harvested along the coast from Point Barrow to the Skull Cliff area. The distance of the leads from shore varies from year to year. The leads generally are parallel and quite close to shore, but occasionally they break directly from Point Barrow to Point Franklin and force Barrow whalers to travel over the ice as much as 10 mi offshore to the open leads. Typically, the lead is open from Point Barrow to the coast, and hunters whale only 1 to 3 mi from shore. A stricken whale can be chased in either direction in the lead. Spring whaling in Barrow is conducted almost entirely with skin boats, because the narrow leads prohibit the use of aluminum skiffs, which are more difficult to maneuver than the traditional skin boats (ACI, Courtnage, and Braund, 1984; Stephen R. Braund and Associates and University of Alaska, Institute for Social and Economic Research [UAA, ISER], 1993). Fall whaling occurs east of Point Barrow from the Barrow vicinity to Cape Simpson. Hunters use aluminum skiffs with outboard motors to chase the whales during the fall migration, which takes place in open water up to 30 mi offshore.

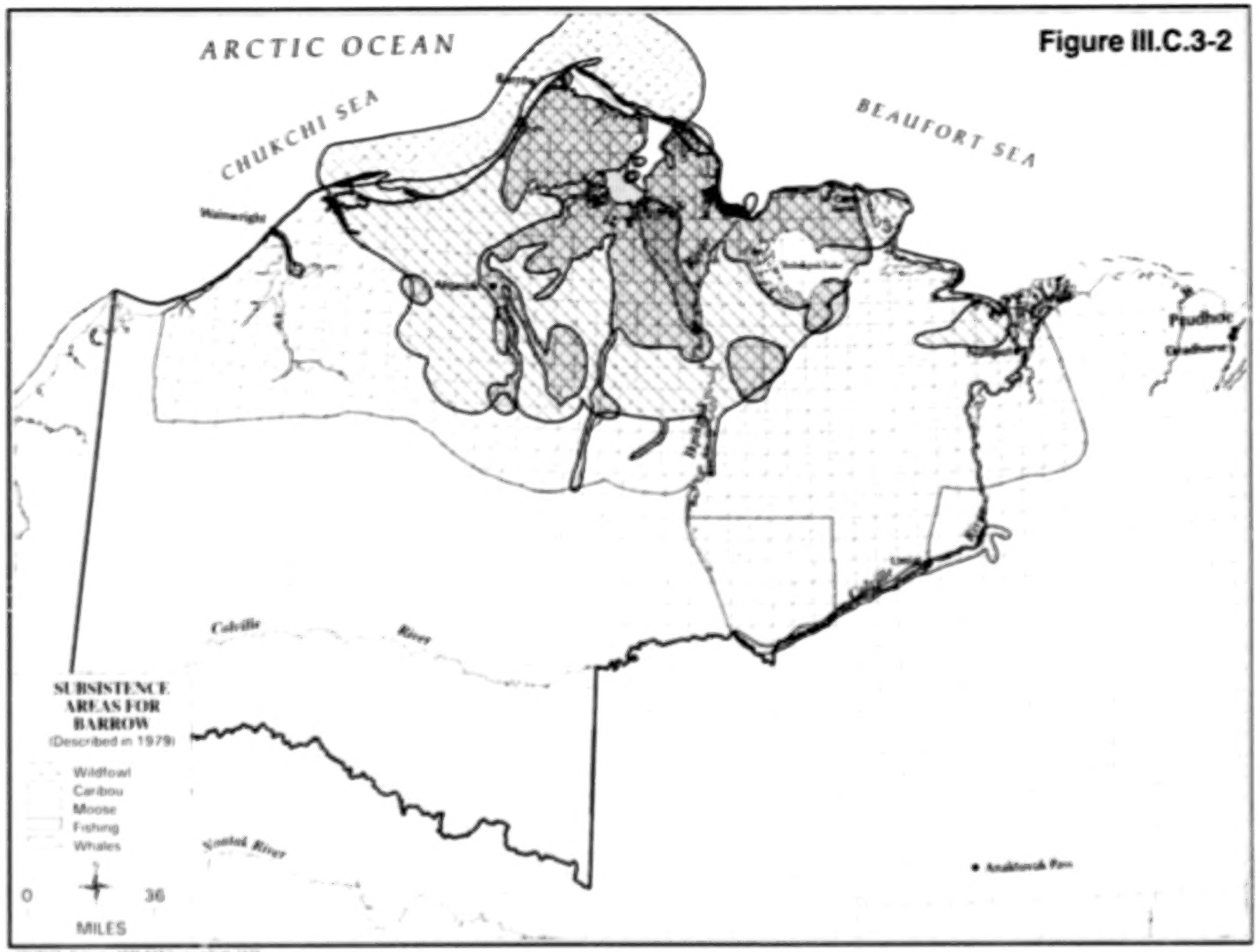
No other marine mammal is harvested with the intensity and concentration of effort that is expended on the bowhead whale. Bowheads are very important in the subsistence economy, and they accounted for 21.3 percent (an average of 10.10 whales/year) of the annual subsistence harvest from 1962 to 1982 (ACI, Courtnage, and Braund, 1984). From 1987 through 1990, Braund (1993) conducted a 3-year subsistence study in Barrow. Table III.C.3-5 shows the number of various subsistence species harvested by year and the 3-year average reported in the study. During the last year of the study, harvest data indicate that 58.2 percent of the total harvest was marine mammals and 43.3 of the total harvest was bowhead whales (ADF&G, 1995b; Table III.C.3-6). As with all species, the harvest of bowheads varies from year to year; over the past 30 years, the number taken each year has varied from 0 to 23. In the memory of community residents, 1982 is the only year in which a bowhead whale was not harvested (ACI, Courtnage, and Braund, 1984; Stephen R. Braund and Associates and UAA, ISER, 1993).

(b) **Belukha Whales**: Belukha whales are available from the beginning of whaling season through June and occasionally in July and August in ice-free waters (Fig. III.C.3-3). Barrow hunters do not like to hunt belukha whales during the bowhead hunt for fear of scaring them. The hunters harvest belukhas after the spring bowhead season ends, which depends on when the bowhead quota is achieved. Belukhas are harvested in the leads between Point Barrow and Skull Cliff. Later in summer, belukhas occasionally are harvested on both sides of the barrier islands of Elson Lagoon. The annual average belukha harvest over the 20-year period from 1962 to 1982 is estimated at five whales, or 5 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). In Braund's (1993) study, there were no harvests of belukha whales in the 3-year period of data collection (Stephen R. Braund and Associates and UAA, ISER, 1993; ADF&G, 1995b; Table III.C.3-6). During the period 1982 to 1996, belukhas were taken very rarely at Barrow, with an annual average of about one per year. In 1997, five belukhas had been taken as of August (Suydam, 1997, pers. comm.).

(c) **Caribou**: Caribou, the primary terrestrial source of meat for Barrow residents, are available throughout the year, with peak-harvest periods from February through early April and from late June through late October (Fig. III.C.3-3). The Barrow subsistence-harvest area for caribou blankets the entire planning area, east to Nuiqsut, south to the headwaters of the Awuna, and west to the coast and the vicinity of Wainwright (Schneider, Pedersen, and Libbey, 1980). Over the 20-year period from 1962 to 1982, residents harvested an annual average of 3,500 caribou, which accounted for 58.2 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). In the last year of Braund's 3-year Barrow subsistence study, caribou provided 22.2 percent of the total edible pounds harvested (Stephen R. Braund and Associates and UAA, ISER, 1993; ADF&G, 1995b, Table III.C.3-6).

(d) **Seals**: Hair seals are available from October through June; however, because of the availability of bowheads, bearded seals, and caribou during various times of the year, seals are harvested primarily during the winter months, especially from February through March (Fig. III.C.3-3). Ringed seals are the most common hair seal species harvested. Spotted seals are harvested only in the ice-free summer months. Ringed seal hunting is concentrated in the Beaufort Sea, although some hunting occurs off Point Barrow and along the barrier islands that form Elson Lagoon. During the winter, leads in the area immediately adjacent to Barrow and north toward the point

Figure III.C.3-2



SUBSISTENCE AREAS FOR BARROW (Described in 1979)

SOURCES: Pedersen, 1979; NSB Contract Staff, 1979

BEST COPY AVAILABLE

BLANK PAGE

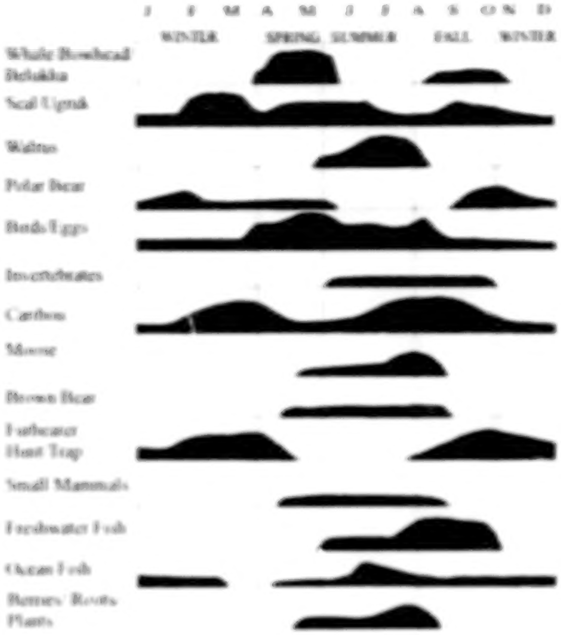


Figure III.C.3-3
Barrow Annual Subsistence Cycle. Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources. (Data for sheep are unavailable.) Source: North Slope Borough Contract Staff, 1979.

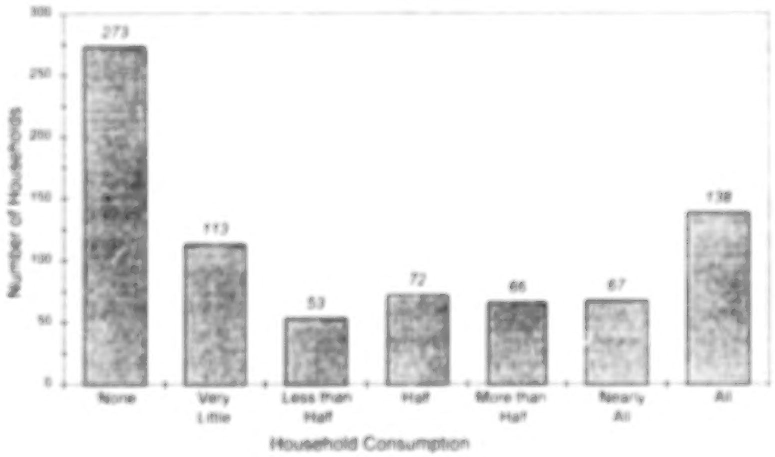


Figure III.C.3-4
Barrow Household Consumption of Meat, Fish, and Birds from Subsistence Activities. These results include only those households that participated in the census survey. Source: Harcharek, 1995.

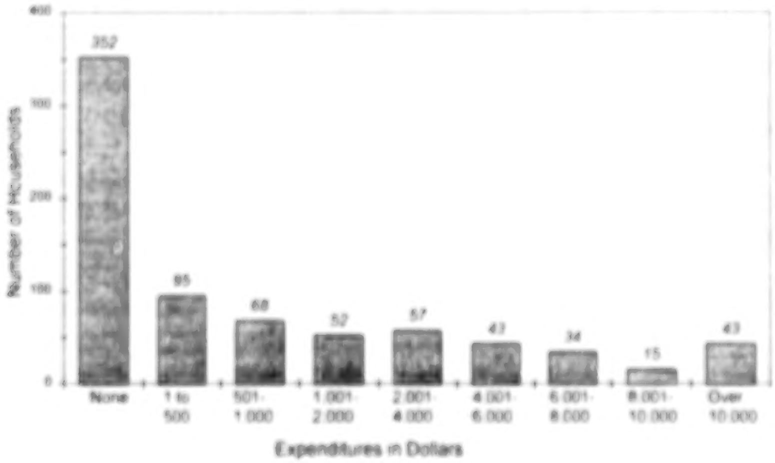


Figure III.C.3-5
Barrow Household Expenditures on Subsistence Activities. These results include only those households that participated in the census survey. Probably no one spends more than $10,000 as an average over several years, but individuals could purchase a boat or incur some other major expense for the year surveyed. Source: Harcharek, 1995.

210

make this area an advantageous spot for sealing. Spotted seals also are harvested occasionally off Point Barrow and the barrier islands of Elson Lagoon. Oarlock Island in Admiralty Bay is a favorite place for hunting spotted seals. From 1962 to 1982, hair seal harvests were estimated at between 31 and 2,100 seals a year. The average annual harvest from 1962 to 1982 is estimated at 955 seals, or 4.3 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). In the last year of Braund's 3-year Barrow subsistence study, ringed seals provided 2.1 percent of the total edible pounds harvested (Stephen R. Braund and Associates and UAA, ISER, 1993; ADF&G, 1995b; Table III.C.3-6).

The hunting of bearded seals (ugruk) is an important subsistence activity in Barrow, because the bearded seal is a preferred food and because bearded seal skins are sought after for covering material for skin boats used for whaling—six to nine skins are needed to cover a boat. Bearded seals are harvested more than the smaller hair seals because of their larger size and because their skins are preferred. They are hunted from spring camps in the Beaufort Sea and from open water during the concurrent pursuit of other marine mammals. Most bearded seals are harvested during the spring and summer months; occasionally, they are available in Dease Inlet and Admiralty Bay. No early harvest data were available for the number of bearded seals harvested annually; thus, the annual subsistence harvest averaged over 20 years from 1962 to 1982 was only 150 seals, or about 2.9 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). Harvests from 1988 to 1989 were documented at 213 seals, providing 6.0 percent of the total edible pounds harvested (Stephen R. Braund and Associates and UAA, ISER, 1993; Table III.C.3-6).

(e) Fish: Barrow residents harvest marine and riverine fish but their dependency on fish varies according to the availability of other resources. Capelin, char, cod, grayling, salmon, sculpin, trout, and whitefish are harvested (ACI, Courtnage, and Braund, 1984). Fishing occurs primarily in the summer and fall months and peaks in September and October (Fig. III.C.3-3). Fishing also occurs concurrently with caribou

Table III.C.3-5
Number of Animals Harvested, Barrow 1987-1990 (weighted)

	Year 1	Year 2	Year 3	3-Year Average
Bowhead whale	7	11	10	9
Walrus	84	61	101	81
Bearded Seal	236	179	109	174
Ringed Seal	466	388	328	394
Spotted Seal	2	4	4	3
Polar Bear	12	11	39	21
Belukha Whale	0	0	0	0
Caribou	1,595	1,533	1,656	1,595
Moose	52	53	40	48
Dall Sheep	12	12	9	11
Brown Bear	1	1	0	1
Porcupine	5	0	0	2
Ground Squirrel	24	0	17	14
Wolverine	4	2	1	2
Arctic Fox	192	146	48	129
Red Fox	8	4	2	5
Wolf	3	0	0	0
Ermine	0	0	0	0
Whitefish	27,366	20,628	38,053	28,683
Nonspecified	5,108	173	0	1,760
Round	2,122	721	16	953
Broad—rv &lake	10,579	11,431	30,047	17,352
Humpback	1,225	647	3,648	1,840
Least Cisco	7,024	7,505	2,929	5,819
Arctic Cisco	1,309	151	1,413	958
Grayling	12,664	8,684	8,392	9,914
Arctic Char	38	76	135	83
Burbot	1,086	392	550	676
Lake Trout	153	72	216	147
Northern Pike	2	0	10	4
Salmon	196	80	2,089	788
Nonspecified	66	3	439	169
Chum	11	5	529	182
Pink	12	1	261	92
Silver	103	70	828	334
King	4	1	31	12
Capelin	3,960	0	346	1,435
Rainbow Smelt	97	0	1,480	526
Arctic Cod	0	7,945	17,018	8,321
Arctic Flounder	0	0	0	0
Tomcod	0	194	0	65
Sculpin	0	11	0	4
Geese	2,873	3,334	3,943	3,384
Nonspecified	329	69	34	144
Brant	127	221	973	440
White-Fronted	2,417	3,035	2,932	2,795
Snow	0	8	4	4
Canada	0	1	1	1
Eiders	5,173	4,499	8,590	6,087
Ptarmigan	2,454	1,350	329	1,378
Other Birds	79	0	9	30

Source: Adapted from Stephen R. Braund & Associates, 1993

Table III.C.3-6
Barrow 1989 Subsistence-Harvest Summary for Marine Mammals, Terrestrial Mammals, Fish, and Birds

	Total Number Harvested	Edible Pounds Harvested			Household Percent Participation
		Total	Household Harvest Mean	Per capita	
Marine Mammals					
Total Marine Mammals	594	508,181	542.35	168.5	45.0
Bowhead Whale	13	377,647	403.04	125.21	45.0
Belukha Whale	0	0	0.00	0.00	0.0
Walrus	101	77,987	83.23	25.86	13.0
Polar Bear	39	19,471	20.78	6.46	4.0
Bearded Seal	109	19,152	20.44	6.35	11.0
Ringed Seal	328	13,774	14.70	4.57	11.0
Spotted Seal	4	151	0.16	0.05	[c]
Terrestrial Mammals					
Large Land Mammals	1,705	214,676	229.11	71.18	39.0
Brown Bear	0	0	0.00	0.00	0.0
Caribou	1,656	193,744	206.77	64.24	39.0
Moose	40	20,014	21.36	6.64	6.0
Muskox	0	0	0.00	0.00	0.0
Dall Sheep	9	918	0.98	0.30	2.0
Small Land Mammals/ Furbearers	68	7	0.01	0.00	2.0
Arctic Fox	49[a]	0	0.00	0.00	[c]
Red Fox	2[a]	0	0.0	0.00	[c]
Marmot	0	0	0.00	0.00	0.0
Mink	0	0	0.00	0.00	0.0
Parka Squirrel	17	7	0.01	0.00	[c]
Weasel	0	0	0.00	0.00	0.0
Wolf	0	0	0.00	0.00	0.0
Wolverine	1	0	0.00	0.00	[c]
Fish					
Total Fish	68,287	118,471	126.44	39.28	61.0
Total Salmon	2,088	12,244	13.07	4.06	10.0
Total Nonsalmon	66,199	106,226	113.37	35.22	13.0
Smelt	1,825	247	0.26	0.08	2.0
Cod	17,018	3,404	3.63	1.13	5.0
Burbot	950	2,202	2.35	0.73	7.0
Char	350	1,239	1.32	0.41	5.0
Grayling	8,393	6,714	7.17	2.23	9.0
Total Whitefish	38,054	92,399	98.61	30.64	18.0
Broad Whitefish	30,047	78,921	84.23	26.17	–
Cisco	2,929	2,929	3.13	0.97	3.0
Humpback Whitefish	3,648	9,119	9.73	3.02	10.0
Birds					
Total Birds and Eggs	12,869	29,446	31.43	9.76	41.0
Migratory Birds	12,539	29,215	31.18	9.69	37.0
Ducks	8,589	12,883	13.75	4.27	37.0
Eider	8,585	12,877	13.74	4.27	37.0
Oldsquaw	2	4	0.00	0.00	0.0
Geese	3,944	16,289	17.38	5.40	13.0
Brant	973	2,920	3.12	0.97	4.0
Snow Geese	4	19	0.02	0.01	0.0
White Fronted	2,932	13,193	14.08	4.37	12.0
Seabirds and Loons	3	9	0.01	0.00	[c]
Ptarmigan	329	231	0.25	0.08	5.0
Bird Eggs	–	–	–	–	–

Number of households in the sample = 101, number of households in the community = 937
Source: ADF&G, Community Profile Database, 1995b. Footnotes: [a]Not eaten. [b]Some not eaten. [c]Percent harvesting less than 0.1%.

hunting in the fall. From December through March, communities fish for tomcod through the ice. The subsistence-harvest area for fish is extensive, primarily because Barrow residents supplement their camp food with fish whenever they are hunting. From Peard Bay west of Barrow to east of Pitt Point on the Beaufort Sea coast, marine fishing occurs in the summer in conjunction with the pursuit of other subsistence resources. Most fishing occurs closer to Barrow in three areas: (1) along the Beaufort Sea coastline from Point Barrow to Walakpa Bay, (2) inside Elson Lagoon near Barrow, and (3) along the barrier islands of Elson Lagoon (Craig, 1987). From Barrow to Peard Bay, fishing occurs primarily during the spring and summer hunts for waterfowl and marine mammals. Intensive marine fishing takes place in the area of the Beaufort Sea just west of the point immediately adjacent to Barrow. In Elson Lagoon and along the Beaufort Sea coast and in Dease Inlet and Admiralty Bay, fishing occurs during the summer and fall from caribou hunting camps, fall-whaling stations, and other camps. Fishing is conducted with gillnets and by jigging. Species harvested include whitefish, least cisco, grayling, and a few burbot and salmon (Craig, 1987). Fish camps have been established at traditional family sites along the coast. These camps generally are on points of land, at the mouths of rivers, and at other strategic locations.

While coastal fishing can be an important source of fish, most of the fishing occurs at inland fish camps, particularly in lakes and rivers that flow into the southern end of Dease Inlet (Craig, 1987). Inland fish camps are found in the Inaru, Meade, Topagoruk, Chipp, Alaktak, and Ikpikpuk river drainages and as far as Teshekpuk Lake. Inland fisheries within or adjacent to the planning area are those on the Alaktak and Ikpikpuk drainages and on Teshekpuk Lake. Here at established fish camps, hunters place set nets for whitefish, char, and salmon. These camps provide good fishing opportunities as well as access to inland caribou and birds. When whitefish and grayling begin to migrate out of the lakes into the major rivers in August, inland fishing intensifies. This also is the period of peak collection of berries and greens (Schneider, Pedersen, and Libbey, 1980; ACI, Courtnage, and Braund, 1984). During 1969 to 1973, the average annual harvest of fish was about 80,000 lb (Craig, 1987); from 1962 to 1982, the estimated annual average was 60,000 lb, which accounts for 6.6 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). In a 1986 partial estimate of fish harvests for the Barrow fall fishery in the Inaru River, the catch composition was least cisco (45%), broad whitefish (36%), humpback whitefish (16%), arctic cisco (1%), fourhorn sculpin (1%), and burbot (0.5%) (Craig, 1987). In Braund's (1993) study, 1989 to 1990 fish harvests provided 13.5 percent of the total edible subsistence harvest (Stephen R. Braund and Associates and UAA, ISER, 1993; Table III.C.3-6).

(f) Walruses: Walruses are harvested during the spring marine-mammal hunt west of Point Barrow and southwest to Peard Bay. Most hunters will travel no more than 15 to 20 mi to hunt walruses. The major walrus-hunting effort occurs from late June through mid-September, with the peak season in August (Fig. III.C.3-3). The annual average harvest from 1970 through 1979 is estimated at 57. The annual average harvest over 20 years from 1962 to 1982 is estimated at 55 walruses, or 4.6 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). Braund's 1987 to 1990 study (Stephen R. Braund & Associates and UAA, ISER, 1993, Table III.C.3-6) indicated an increased walrus harvest; a harvest of 88 walruses provided 10.9 percent of the total edible pounds of meat harvested during this period. From 1989 to 1995, 109 walrus were harvested, from a low of 1 in 1989 to a high of 30 in 1993 (Stephensen, Cramer, and Burn, 1994; Cramer, 1996, pers. comm.).

(g) Migratory Birds: Migratory birds, particularly eider ducks and geese, provide an important food source for Barrow residents. This is not because of the quantity of meat harvested or the time spent hunting them, but because of the dietary importance of birds during spring and summer. In June, geese are hunted and hunters travel great distances along major inland rivers and lakes to harvest them; most eider and other ducks are harvested along the coast (Schneider, Pedersen, and Libbey, 1980). Once harvested extensively, snowy owls are no longer taken regularly. Birds' eggs still are gathered occasionally, especially on the offshore islands where foxes and other predators are less common. Waterfowl—hunted during the whaling season (beginning in late April or early May) when their flights follow the open leads—provide a source of fresh meat for whaling camps. Later in the spring, Barrow residents harvest many geese and ducks; the harvest peaks in May and early June and continues until the end of June (Fig. III.C.3-3). Birds may be harvested throughout the summer, but only incidentally to other subsistence activities. In late August and early September, with peak movement in the first 2 weeks of September, ducks and geese migrate south and are again hunted by Barrow residents. Birds, primarily eiders and other ducks, are hunted along the coast from Point Franklin to Admiralty Bay and Dease Inlet. Concentrated hunting areas also are located along the shores of the major barrier islands of Elson Lagoon. After spring whaling, geese are hunted inland.

A favorite spot for hunting birds is the "shooting station" at the narrowest point of the barrier spit that forms Point Barrow and separates the Beaufort Sea from Elson Lagoon. This area, a highly successful hunting spot during spring and fall bird migrations, is easily accessible to Barrow residents. Barrow residents harvested an estimated annual average from 1962 to 1982 of 8,000 lb of birds, which accounts for about 0.9 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). From 1989 to 1990, 29,215 lb were harvested, accounting for 3.3 percent of the total edible pounds harvested (Stephen R. Braund and Associates and UAA, ISER, 1993; ADF&G, 1995b; Table III.C.3-6).

(h) Polar Bears: Barrow residents hunt polar bears from October to June (Fig. III.C.3-3). Polar bears comprise a small portion of the Barrow subsistence harvest, with an annual average of 7.8 bears harvested from 1962 to 1983, or only 0.3 percent of the annual subsistence harvest (Schliebe, 1983; ACI, Courtnage, and Braund, 1984). From 1989 to 1990, 39 polar bears were harvested, providing 2.2 percent of the total edible pounds harvested (Stephen R. Braund and Associates and UAA, ISER, 1993; ADF&G, 1995b; Table III.C.3-6).

A North Slope Borough subsistence study conducted in 1993 and Figures III.C.3-4 and III.C.3-5 indicate more recent household consumption of subsistence foods and expenditures on subsistence activities (Harcharek, 1995).

(2) Atqasuk: Atqasuk (population 216 in 1990 and 233 in 1996 [USDOC, Bureau of the Census, 1991; ADOL figures as cited in State of Alaska, DCRA, 1996]) is the only inland community close to the planning area. The marine-resource areas used by Atqasuk residents are inclusive of those used by Barrow residents and are discussed in the Barrow discussion. Only a small portion of the marine resources used by Atqasuk residents is acquired on coastal hunting trips initiated in Atqasuk; most are acquired on coastal hunting trips initiated in Barrow or Wainwright with relatives or friends (ACI Courtnage Braund, 1984). Inland, the diversity of resources is less and subsistence opportunities restricted to fewer species. Atqasuk hunters harvest the community's key resources of caribou, fish, and migratory waterfowl; some of these harvest areas overlap with those of Barrow. Areas exclusive to the community and heavily used by local subsistence hunters are: the middle and upper Meade and Avalik rivers, the upper Okpiksak, the Topagoruk, and the Nigisaktuvik rivers (Schneider, Pedersen, and Libbey, 1980; Stephen R. Braund and Associates and UAA, ISER, 1993). Atqasuk's subsistence-harvest area can be seen in Figure III.C.3-1. Subsistence resources used by Atqasuk are listed in Table III.C.3-1 by common species name, Inupiaq name, and scientific name. Specific subsistence harvest areas for major subsistence resources for Atqasuk are shown in Figure III.C.3-6. Levels of subsistence participation by Atqasuk households for 1988 are shown in Table III.C.3-7.

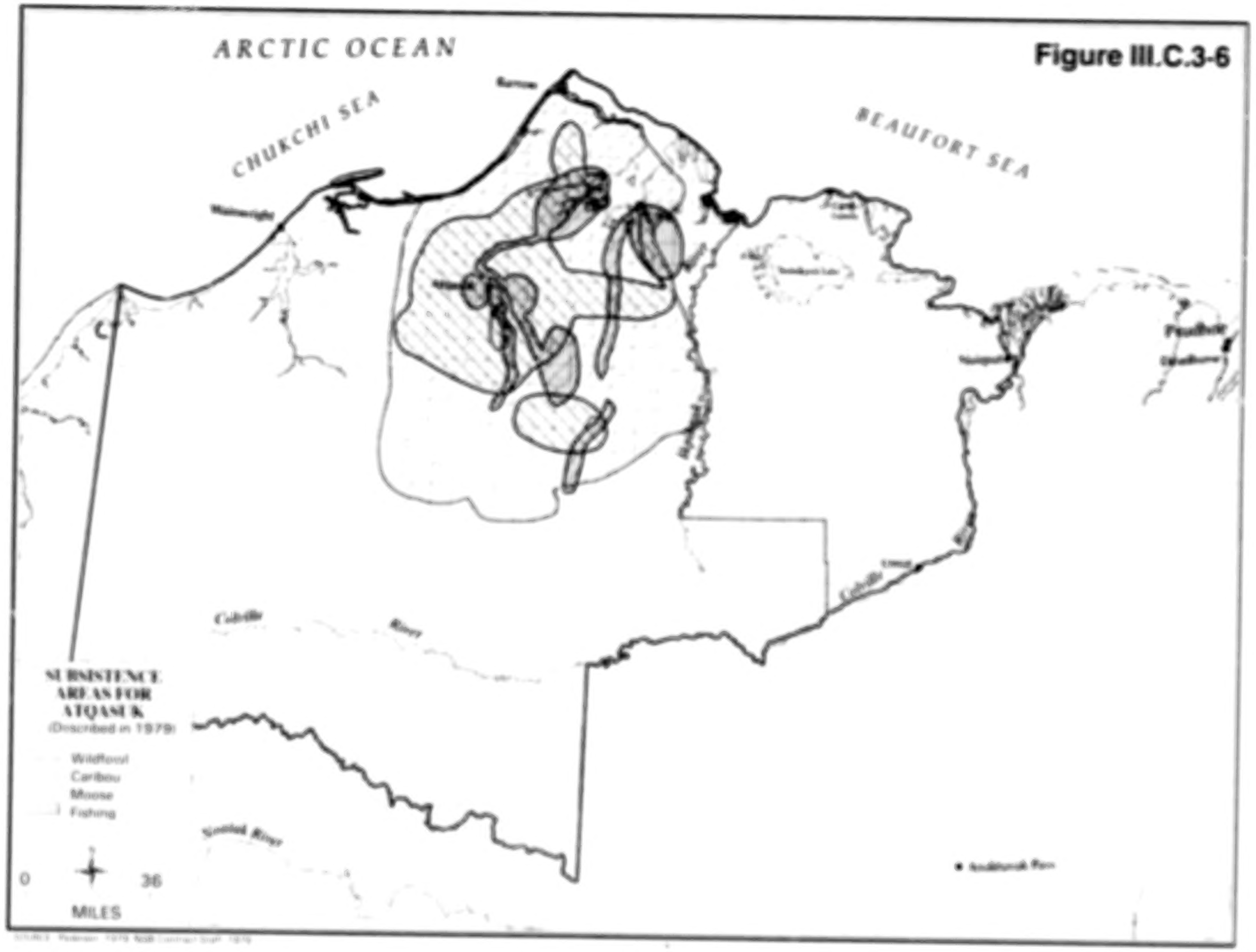
(a) Caribou: Caribou is the most important resource harvested by Atqasuk residents. Although the late summer-early fall harvest is the most important, caribou also are harvested throughout the winter and in early spring (Fig. III.C.3-7). Caribou migration patterns and limited access prohibit hunting in the late spring and early summer. A subsistence-harvest survey conducted by the NSB Department of Wildlife Management (DWM) covering the period from July 1994 to June 1995 reported 187 caribou harvested by Atqasuk hunters (57% of the total subsistence harvest in edible pounds; Table III. C.3-8; Opie, Brower, and Bates, In prep.).

In recent years, the caribou population has been high, and Atqasuk residents have not had to travel far to hunt (distances are not available). Caribou are hunted by boat and snowmachine and on foot from caribou camps along the Meade, Inaru, Topagoruk, and Chipp river drainages, which also are used for fishing. Caribou hunting by snowmachine involves considerable travel over a widespread area (Schneider, Pedersen, and Libbey, 1980; ACI, Courtnage, and Braund, 1984).

(b) Fish: Fish is a preferred food in Atqasuk, although in an ACI, Courtnage, and Braund study (1984) respondents indicated that fish is the secondary resource in quantity harvested. Summer gillnetting, hook and line, late fall and winter jigging through ice, and winter gillnetting under the ice are the four common fishing techniques. The most productive season is summer gillnetting during July and August. Most fishing occurs along the Meade River a few miles from the village but is also pursued in most rivers, streams, and deeper lakes of the region. Fish camps also are located on two nearby rivers, the Usuktuk and the Nigisaktuvik, and downstream on the Meade River near the Okpiksak River (Craig, 1987). The most prevalent subsistence-fishing activity is catching humpback whitefish and least cisco in gillnets. Also caught are broad whitefish, burbot, grayling, and chum salmon (only caught in some years), which are fished with gillnets and baited hooks and by jigging (Craig, 1987). The most successful fishing months are July and August (Fig. III.C.3-7), when water levels drop in the Meade River and the water becomes clearer. Nets are most commonly set close to the community. During the fall and winter, fishing continues under the ice in the Meade River and in nearby lakes (Schneider, Pedersen, and Libbey, 1980; ACI, Courtnage, and Braund, 1984; Stephen R. Braund and Associates and UAA, ISER, 1993).

Humpback whitefish and least cisco accounted for 96 percent of the summer catch in 1983 (the only year of harvest data). The summer gillnet fishery in the Meade and Usuktuk rivers produced a harvest of approximately 8, 450 lb of fish. Adding catches with other gear (angling) and winter catches (1,100 lb and 2,700 lb, respectively), the total harvest was approximately 12,250 lb. The annual per capita catch in 1983 was about 43 lb, with 231 residents in

Figure III.C.3-6



SOURCE: Pedersen, 1979; NSB Contract Staff, 1979

BEST COPY AVAILABLE

215

BLANK PAGE

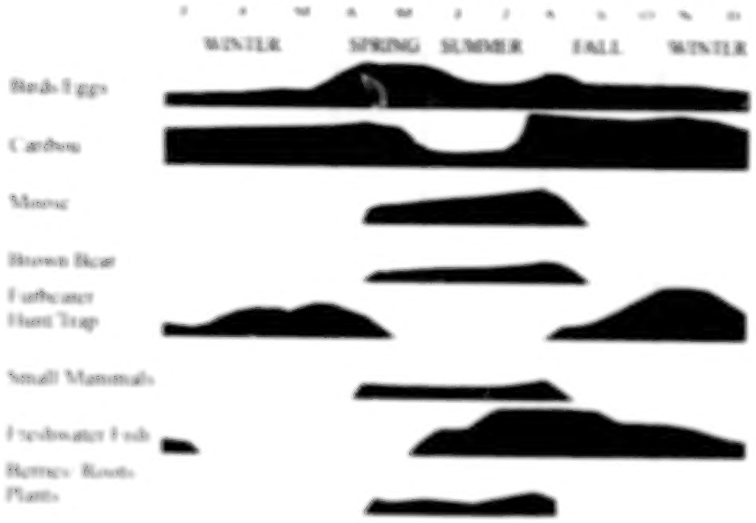


Figure III.C.3-7
Atqasuk Annual Subsistence Cycle. Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources. (Data for sheep are unavailable. Whales, seal, walrus, polar bear, invertebrates, and ocean fish are harvested only out of hunts originating in Barrow.) Source: North Slope Borough Contract Staff, 1979.

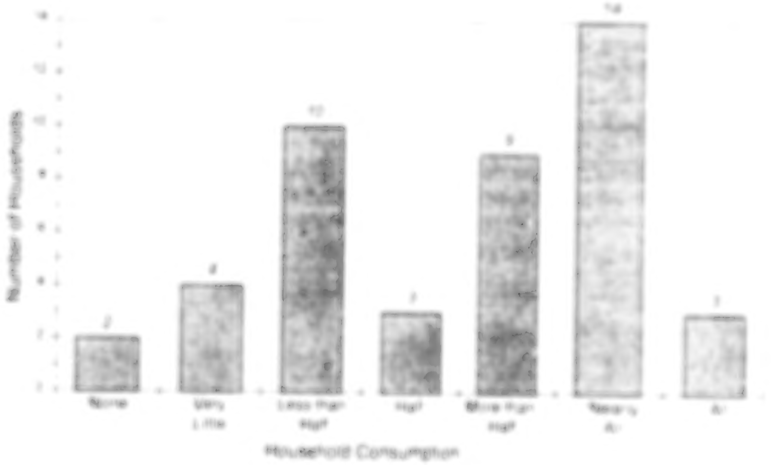


Figure III.C.3-8
Atqasuk Household Consumption of Meat, Fish, and Birds from Subsistence Activities. These results include only those households that participated in the census survey. Source: Harcharek, 1995.

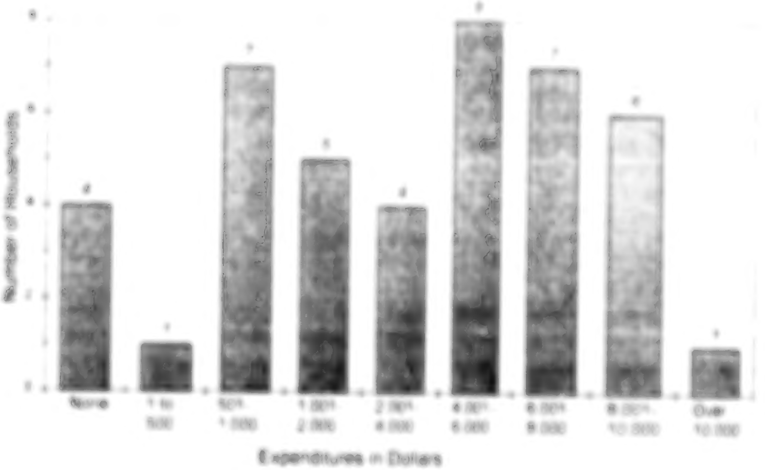


Figure III.C.3-9
Atqasuk Household Expenditures on Subsistence Activities. These results include only those households that participated in the census survey. Probably no one spends more than $10,000 as an average over several years, but individuals could purchase a boat or incur some other major expense for the year surveyed. Source: Harcharek, 1995.

Table III.C.3-7
Atqasuk Household Characteristics, 1988, by Levels of Subsistence Participation

	Degree of Subsistence Participation			
	Minimal	**Moderate**	**Active**	**All HH's***
Average HH Income ($):				
Inupiat HH's	$26,250	$17,500	$30,556	
Non-Inupiat HH's	$85,000	$57,500	$45,000	
All HH's	$43,529	$27,500	$32,000	$36,431
Cases:	17	4	20	41
Average HH Size (# Persons per HH):				
Inupiat HH's	4.2	4.5	4.8	
Non-Inupiat HH's	3.2	2.0	2.0	
All HH's	3.9	4.0	4.6	4.3
Cases:	17	5	23	45
Average Meat & Fish Consumption From Own HH Subsistence (%):				
Inupiat HH's	13.8%	35.0%	78.1%	
Non-Inupiat HH's	6.0%	25.0%	75.0%	
All HH's	11.5%	33.0%	77.8%	47.8%
Cases:	17	5	23	45
Average Meat & Fish Consumption from Other HH Subsistence (%):				
Inupiat HH's	12.9%	5.0%	17.7%	
Non-Inupiat HH's	0.0%	0.0%	50.0%	
All HH's	9.1%	4.0%	20.5%	14.4%
Cases:	17	5	23	45
Average Meat & Fish Harvested and Given Away (%):				
Inupiat HH's	5.4%	10.0%	18.3%	
Non-Inupiat HH's	2.0%	0.0%	45.0%	
All HH's	4.4%	8.0%	20.7%	13.1%
Cases:	17	5	23	45
Average Proportion HH Income Spent in Village (%):				
Inupiat HH's	77.5%	62.5%	82.6%	
Non-Inupiat HH's	13.0%	25.0%	65.0%	
All HHs	58.5%	55.0%	81.1%	69.7%
Cases:	17	5	23	45

* Household. **Notes:** Degree of subsistence participation measured on the basis of how much HH meat and fish consumption was from the HHs own subsistence activities, where **Minimal** = under 20% meat and fish from own HH subsistence, **Moderate** = 20–40% meat and fish from own HH subsistence, **Active** = over 40% meat and fish from own HH subsistence. Total cases (households) = 55. Adapted from: Impact Assessment, Inc., 1990, citing NSB Department of Planning and Community Services, Census of Population and Economy.

the village (Craig, 1987). A subsistence-harvest survey conducted by the NSB DWM covering the period from July 1994 to June 1995 reported that fish harvests by Atqasuk hunters represented 37 percent of the total subsistence harvest in edible pounds. (Table III.C.3-8, Opie, Brower, and Bates, 1997).

(c) **Migratory Birds**: Atqasuk residents harvest migratory birds (especially geese) from late April through June when they begin to appear along rivers, lakes, and the tundra, following the snowline north (Fig. III.C.3-7). This also is the time when ptarmigan are harvested and bears and moose appear. Waterfowl are hunted continually through June and July along the major rivers from late August through September on numerous lakes and ponds as well as on the Meade River and its tributaries. Eggs are gathered in the immediate vicinity of the community for a short period in June (ACI, Courtnage, and Braund, 1984; Stephen R. Braund and Associates and UAA, ISER, 1993). A subsistence-harvest survey conducted by the NSB DWM covering the period from July 1994 to June 1995 reported that bird harvests by Atqasuk hunters represented 3 percent of the total subsistence harvest in edible pounds (Table III.C.3-8, Opie, Brower, and Bates, In prep.).

Figures III.C.3-8 and III.C.3-9, taken from an NSB subsistence study conducted in 1993, indicate more recent trends in Atqasuk household consumption of subsistence

Table III.C.3-8
Subsistence Harvest by Month for Atqasuk, July 1, 1994, to June 30, 1995

	1994						1995						Total	Est. Total
Item	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	51 HH's*	56 HH's
Arctic Char	0	0	0	0	0	0	0	0	0	0	0	0		
Arctic Cisco	0	0	0	0	0	0	0	0	0	0	0	0		
Broad Whitefish	0	100	1,050	130	0	0	0	0	0	0	0	350	1,630	1,790
Burbot	0	0	10	130	22	0	0	0	0	0	0	0	162	178
Rainbow Trout	0	0	0	15	0	0	0	0	0	0	0	0	15	16
Grayling	100	850	2,078	2,463	225	0	0	0	0	0	0	0	5,716	6,276
Silver Salmon	0	0	0	10	0	0	0	0	0	0	0	0	10	11
Humpback Whitefish	0	13	150	112	150	0	0	0	0	0	0	75	500	549
Least Cisco	0	0	0	0	0	0	0	0	0	0	0	0		
Northern Pike	0	0	0	0	0	0	0	0	0	0	0	0		
Whitefish Unidentified	0	88	100	1,087	125	0	0	0	0	0	0	0	1,400	1,537
Caribou	31	43	43	25	22	7	1	9	2	0	3	1	187	205
Moose	0	0	0	0	0	0	0	0	0	0	0	0		
Wolf	0	0	0	1	0	0	0	0	1	0	0	0	2	2
Wolverine	0	0	0	0	3	0	0	4	3	0	0	0	19	11
Arctic Fox	0	0	0	0	0	0	0	0	0	0	0	0		
Ground Squirrel	0	0	0	0	0	0	0	0	0	0	6	0	6	7
Red Fox	0	0	0	0	0	0	0	0	0	0	0	0		
Geese Unidentified	0	0	0	0	0	0	0	0	0	0	168	0	168	184
Eider Unidentified	0	0	0	0	0	0	0	0	0	0	12	0	12	13
White fronted Goose	0	0	0	0	0	0	0	0	0	0	76	0	76	83
Canada Goose	0	0	0	0	0	0	0	0	0	0	2	0	2	2
Brant	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Ptarmigan	0	0	0	0	0	0	0	0	0	0	16	0	16	18
Ringed Seal	4	0	0	0	0	0	0	0	0	0	0	0	4	4
Bearded Seal	4	0	0	0	0	0	0	0	0	0	0	0	4	4
Salmonberries (gal)	0	72	0	0	0	0	0	0	0	0	0	0	72	79
Cranberries (gal)	0	0	0	0	0	0	0	0	0	0	0	0		
Blueberries (gal)	2	0	10	0	0	0	0	0	0	0	0	0	12	13

* Households. Source: Opie, Brower, and Bates 1997.

foods and expenditures on subsistence activities (Harcharek, 1995).

(3) **Nuiqsut**: Nuiqsut (population 354 in 1990 and 410 in 1995 [USDOC, Bureau of the Census, 1991; ADOL figures as cited in ADF&G, 1995b]) is situated near the mouth of the Colville River, which drains into the Beaufort Sea. For Nuiqsut, important subsistence resources include bowhead whales, caribou, and fish as well as belukha whales, seals, walruses, polar bears, and marine and coastal birds. Much of Nuiqsut's terrestrial subsistence-harvest area lies within the proposed planning area. Nuiqsut's subsistence-harvest area can be seen in Figure III.C.3-1. Specific subsistence-harvest areas for major subsistence resources for Atqasuk are shown in Figure III.C.3-10. The preferred harvest periods for Nuiqsut are indicated in Figure III.C.3-11. Subsistence resources used by Nuiqsut are listed in Table III.C.3-1 by common species name, Inupiaq name, and scientific name. A summary of subsistence resources harvested in the 1993 and 1994 to 1995 seasons can be seen in Tables III.C.3-9 and III.C.3-10, respectively.

(a) **Bowhead Whales**: Even though Nuiqsut is not located on the coast (it is approximately 25 mi inland with river access to the Beaufort Sea), marine mammals, especially bowhead whales, are a major subsistence resource. Bowhead whaling usually occurs between late August and early October, and the exact timing depends on ice and weather conditions. Also, ice conditions can dramatically extend the season to last >2 months or contract it to <2 weeks (Fig. III.C.3-11). Unlike spring-whaling communities, which hunt the bowhead from the edge of ice leads in skin boats, Nuiqsut whalers use aluminum skiffs with outboard motors to hunt bowheads in open water in the fall. Generally, they whale within 10 mi of shore but at times may travel 20 mi or more from shore. Bowhead whales commonly are harvested by Nuiqsut residents off of Cross Island, but the entire coastal area from Nuiqsut east to Flaxman Island and the Canning River delta may be used. Generally, whalers pursue whales within 10 mi of Cross Island but at times may travel 20 mi or more from the island. In the past, Nuiqsut has not harvested many bowhead whales (20 whales from 1972-1995), however, their success has improved in the past few years, with unsuccessful harvests occurring since 1982 only in the years 1984, 1988, 1993, and 1994 (USDOI, MMS, 1996a). A 1993 ADF&G subsistence survey in Nuiqsut indicated that 31.8 percent of the total subsistence harvest was marine mammals, and 28.7 percent of the total harvest was bowhead whales (ADF&G, 1995b: Table III.C.3-9). The harvest of bowhead whales at Nuiqsut (and at Barrow) greatly affects the percent of total harvest estimates, because in years when whales are taken, other important subsistence species are underrepresented due to the great mass (total pounds harvested) of the whales.

Although in Nuiqsut bowheads are not the main subsistence resource in terms of edible pounds harvested per capita, they remain, as in other North Slope communities, the most culturally prominent to the Inupiat. The bowhead is shared extensively with other North Slope communities and often with Inupiat residents in communities as far away as Fairbanks and Anchorage.

(b) **Belukha Whales**: Belukha whales may be harvested throughout the open-water season (Fig. III.C.3-11) and taken incidentally to the bowhead harvest. Little harvest information is available for Nuiqsut harvests of belukha whales, and the hunt is not significant (see Table III.C.3-9).

(c) **Seals**: Seals are hunted year-round (Fig. III.C.3-11), but the bulk of the seal harvest occurs during the open-water season, with breakup usually occurring in June. In the spring, seals can be hunted once the landfast ice goes out. Henry Nashanknik from Barrow related that seaward of the McClure Islands there were huge pressure ridges that hunters traveled through in the spring, and that not too far out from the pressure ridges there were open leads where they would hunt seals (H. Nasharknik, as cited in Shapiro, Metzner, and Toovak, 1979). When elder Bruce Nukapigak lived at Point McIntyre in the 1930's, he noted there was good seal hunting between Cross and McClure Islands, because there usually was some open water in the channel between the islands (B. Nukapigak, as cited in Shapiro, Metzner, and Toovak, 1979). Nuiqsut elder Samuel Kunaknana, when interviewed in 1979, noted that when the ice is nearshore in the summer, it is considered to be good for seal hunting (S. Kunaknana, as cited in Shapiro, Metzner, and Toovak, 1979). During the winter, these harvests consist almost exclusively of ringed seals taken along open leads in the ocean ice. In summer, boat crews harvest ringed, bearded, and spotted seals; the hunt can take place along the entire Beaufort Sea coast from Cape Halkett to Anderson Point. While seal meat is eaten, the dietary significance of seals primarily comes from seal oil, served with almost every meal that includes subsistence foods. Seal oil also is used as a preservative for meats, greens, and berries. Seal skins are important in the manufacture of clothing and, because of their beauty, spotted seal skins often are preferred for making boots, slippers, mitts, and parka trim. In practice, however, ringed seal skins are used more often in the making of clothing because the harvest of this species is more abundant. A 1993 ADF&G subsistence survey in Nuiqsut indicate that 31.8 percent of the total subsistence harvest was marine mammals, and 3.1 percent of the total harvest was seals (ADF&G, 1995b, Table III.C.3-9).

(d) **Walruses**: Walruses also are occasionally harvested during the open-water season from June through early October (Fig. III.C.3-11). Walrus hunting occurs along the entire Beaufort Sea coast from Cape Halkett to Anderson Point. Recent ADF&G subsistence-survey data indicate that a single walrus was harvested in 1985; no new walrus data for the community have been gathered since then (see Table III.C.3-9; ADF&G, 1993a, 1995b).

(e) **Polar Bears**: The harvest of polar bears by Nuiqsut hunters begins in mid-September and extends into late winter (Fig. III.C.3-11). Polar bear meat is eaten, although little harvest data are available. One bear was harvested in the 1962 to 1982 period; for the period 1983 to 1995 Nuiqsut harvested 20 polar bears (see Tables III.C.3-9 and III.C.3-10; Schliebe, 1995; ADF&G, 1993a, 1995b). According to whaling captain Thomas Napageak's statement at the Beaufort Sea Sale 144 Public Hearings in Nuiqsut, the taking of polar bear is not very important now because Federal regulations prevent the selling of the hide as valuable as it is, [it] goes to waste when we kill a polar bear" (USDOI, MMS, Alaska OCS Region, 1995).

(f) **Caribou**: Nuiqsut harvests several large land mammals, including caribou, moose, and brown bears; of these, caribou is the most important subsistence resource. Caribou may be the most preferred mammal in Nuiqsut's diet and, during periods of high availability, it provides a source of fresh meat throughout the year (see Tables III.C.3-9 and III.C.3-10). Data gathered in 1976 show it provided an estimated 90.2 percent of the total subsistence harvest (Stephen R. Braund and Associates, 1993). More recent subsistence caribou-harvest data are shown in Table III.C.3-9 (ADF&G, 1993a, 1995b). Caribou are harvested throughout the year, with peak harvests from April through June and in September and October (Fig. III.C.3-11). Caribou-harvest statistics for 1976 show 400 caribou provided approximately 47,000 lb of meat (Stoker, 1983, as cited in ACI, Courtnage, and Braund, 1984). In 1985, an estimated 513 caribou were harvested, providing an estimated 60,000 edible pounds of meat (37.5% of the total subsistence harvest; ADF&G, 1993a). A 1993 ADF&G subsistence study estimated a harvest of 674 caribou, providing an estimated 82,000 edible pounds of meat (30.6% of the total subsistence harvest ADF&G, 1995b). In 1993, 74 percent of Nuiqsut's households harvested caribou, 98 percent used caribou, 79 percent shared caribou with other households, and 79 percent received caribou shares. This same survey showed that nearly two-thirds of all Nuiqsut households received more than half of their meat, fish, and birds from local subsistence activity. Harvests occurred at 16 locations with the highest harvest at Fish Creek with 111 caribou (Pedersen et al., 1995, as cited in Fall and Utermohle, 1995). A subsistence-harvest survey conducted by the NSB DWM covering the period from July 1994 to June 1995 reported the 249 caribou harvested by Nuiqsut hunters (25% of the total subsistence harvest in edible pounds; see Table III.C.3-10). The report noted this as quite a low number of caribou harvested when compared to reported harvests for earlier years. Explanations offered by local hunters were: (1) the need to travel longer distances to harvest caribou than in the past; (2) the increasing numbers of muskox that hunters believe keep caribou away from traditional hunting areas; and (3) restricted access to traditional subsistence hunting areas due to oil exploration and development in these areas (Brower and Opie, 1997).

Because of the unpredictable movements of the Central Arctic and Teshekpuk Lake caribou herds and because of ice conditions and weather-dependent hunting techniques, Nuiqsut's annual caribou harvest can fluctuate markedly; but when herds are available and when weather permits, caribou are harvested year-round. Elders Samuel and Sarah Kunaknana related that caribou hunters in the past had to go inland to hunt caribou, because they never came down to the coast as they do now (Shapiro, Metzner, and Toovak, 1979). In 1992, caribou and moose accounted for 27 percent of the total subsistence harvest (George and Fuller, In prep.); in 1993, moose and caribou accounted for 33 percent (Pedersen, In prep.); and in the period covered by the NSB subsistence survey (July 1994-June 1995), caribou and moose accounted for 69 percent of the edible pounds of subsistence resources harvested by Nuiqsut hunters (Brower and Opie, 1997). This jump to a much higher percentage for terrestrial mammals is likely explained by an unsuccessful bowhead whale harvest during the study period (Suydam et al., 1994).

(g) Fish: Fish provide the most edible pounds per capita of any subsistence resource harvested by Nuiqsut (see Table III.C.3-9; ADF&G, 1993a, 1995b). The harvests of most subsistence resources, such as caribou, can fluctuate widely from year to year because of variable migration patterns and because harvesting techniques depend on ice and weather conditions, and much the same can be said of the conditions surrounding the bowhead whale hunt. Even though fish-harvest rates (and total catch) do vary from year to year, the harvest of fish is perhaps more consistent than the harvest of terrestrial species. The harvesting of fish is not subject to seasonal limitations, a situation that adds to their importance in the community's subsistence round. Nuiqsut has been shown to have the largest documented subsistence-fish harvest on the Beaufort Sea coast (Moulton, 1997; Moulton, Field, and Brotherton, 1986). Moreover, in October and November, fish may provide the only source of fresh subsistence foods.

Fishing is an important activity for Nuiqsut residents due to the community's location on the Nechelik Channel of the Colville River, which has large resident fish populations. The river supports 20 species of fish, and approximately half of these are taken by Nuiqsut residents (George and Nageak, 1986). Local residents generally harvest fish during the summer and fall, but the fishing season basically runs from January through May and from late July through mid-December (Fig. III.C.3-11). The summer, open-water harvest lasts from breakup to freezeup (early June to mid-September). The summer harvest covers a greater area and is longer than the fall winter harvest in duration, and a greater number of species are caught. Broad whitefish, the primary species harvested during the summer, is the only anadromous species harvested in July in the Nechelik Channel. In July, lake trout, northern pike, broad whitefish, and humpback whitefish are harvested in the Main Channel of the Colville south of Nuiqsut. Traditionally, coastal areas were fished in June and July when rotting ice created enough open water for seining. Nuiqsut elder Sarah Kunaknana, interviewed in 1979, said: "... in the little bays along the coast we start seining for fish (iqalukpik). After just seining 1 or 2 times, there would be so many fish we would have a hard time putting them all away" (Shapiro, Metzner, and Toovak, 1979). Salmon species reportedly have been caught in August but not in large numbers. Pink and chum salmon are the most commonly caught, although there reportedly has not been a great interest in harvesting them (George and Nageak, 1986). Arctic char is found in the Main Channel of the Colville River, but it does not appear to be a major subsistence species because, although apparently liked, it is not abundantly caught (George and Nageak, 1986; George and Kovalsky, 1986; ADF&G, 1993a, 1995b).

The fall winter under-ice harvest of fishes begins after freezeup, when the ice is safe for snowmachine travel. Local families fish for approximately 1 month after freezeup. The Kupigruak Channel is the most important fall fishing area in the Colville region, and the primary species harvested are arctic and least cisco; other fishing for cisco occurs in the Nechelik and Main channels of the Colville River. Arctic and least cisco amounted to 88 and 99 percent of the harvest in 1984 and 1985, respectively; however, this percentage varied greatly depending on the net-mesh size. Humpback and broad whitefish, sculpin,

220

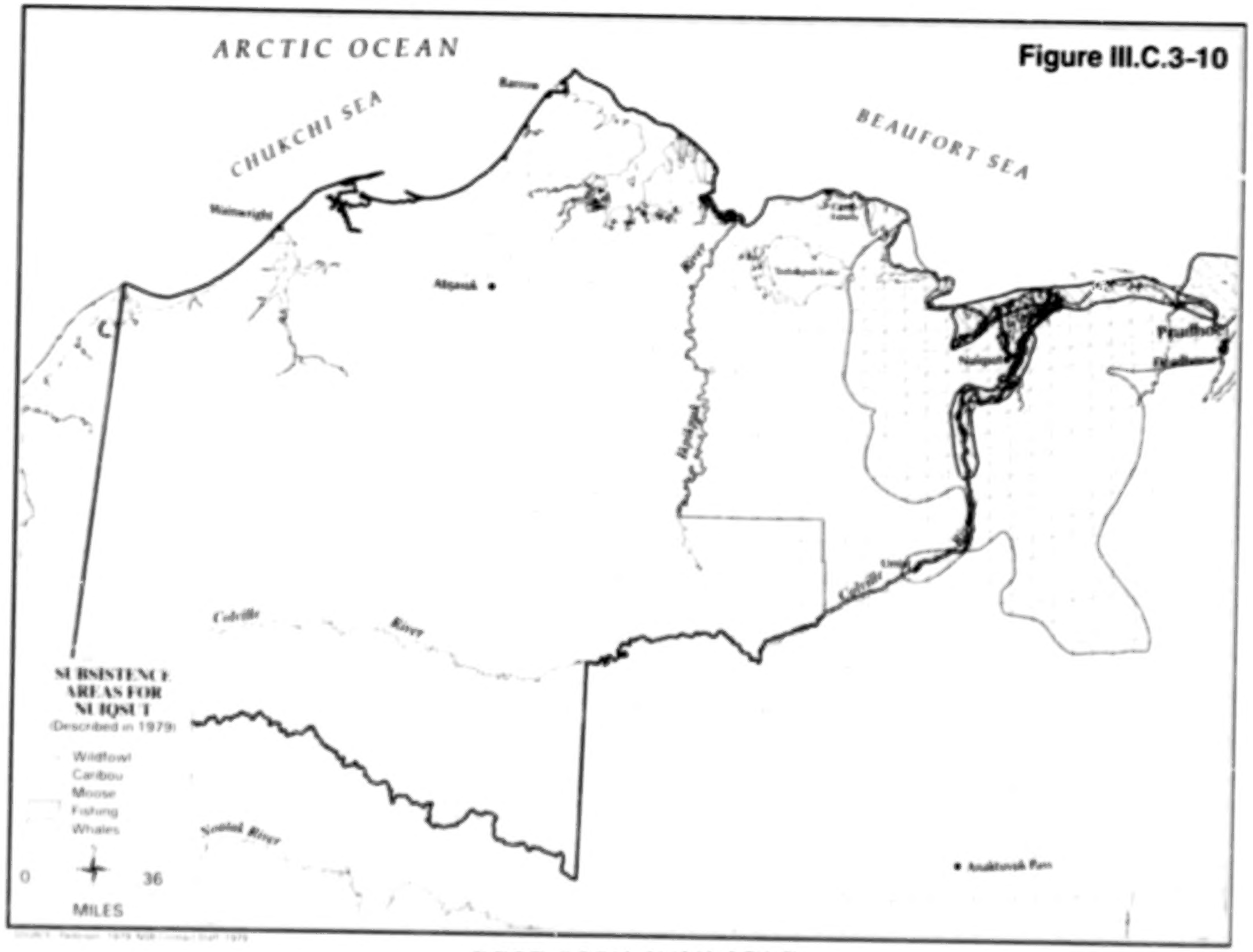


Figure III.C.3-10

BEST COPY AVAILABLE

221

BLANK PAGE

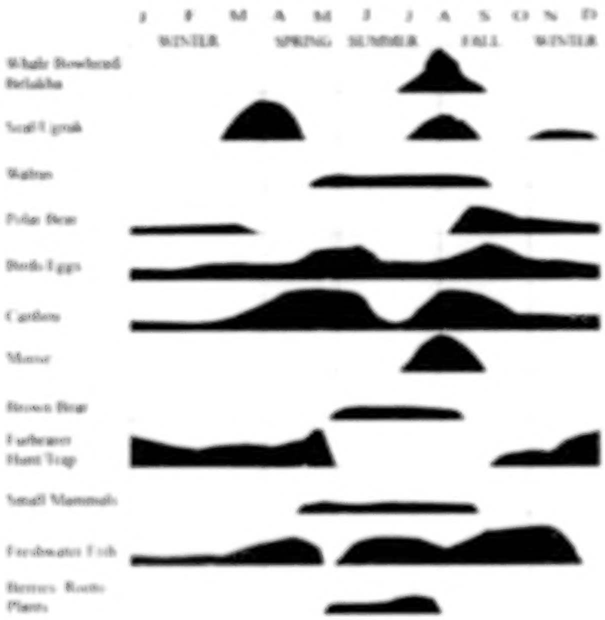


Figure III.C.3-11
Nuiqsut Annual Subsistence Cycle. Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources. (Data for invertebrates, sheep, and ocean fish are unavailable.) Source: North Slope Borough Contract Staff, 1979.

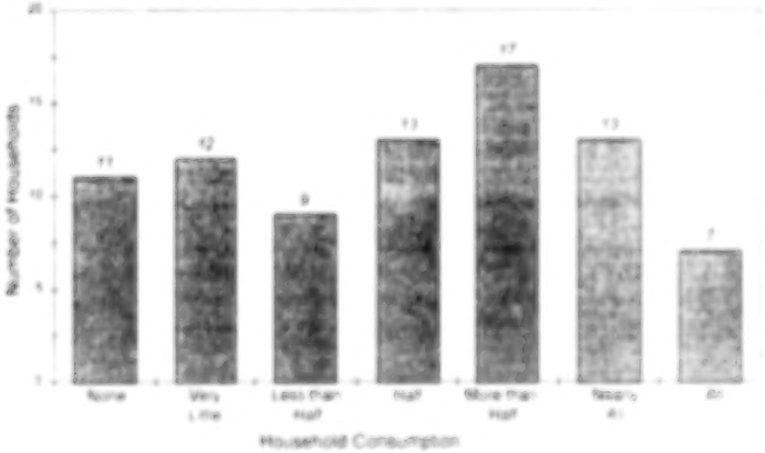


Figure III.C.3-12
Nuiqsut Household Consumption of Meat, Fish, and Birds from Subsistence Activities. These results include only those households that participated in the census survey. Source: Harcharek, 1995

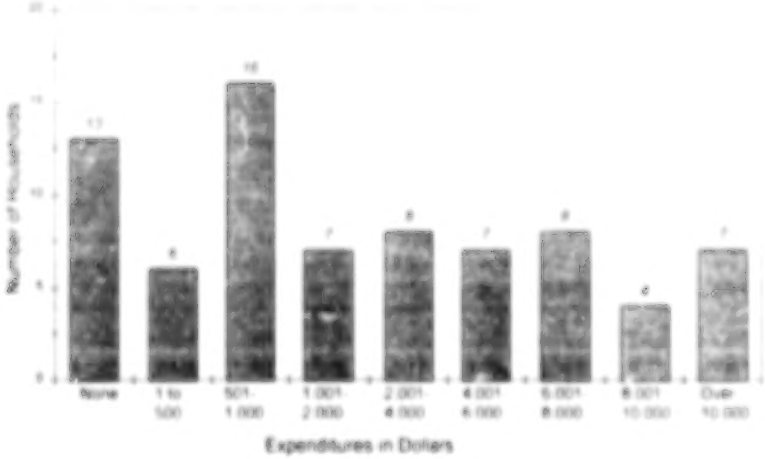


Figure III.C.3-13
Nuiqsut Household Expenditures on Subsistence Activities. These results include only those households that participated in the census survey. Probably no one spends more than $10,000 as an average over several years, but individuals could purchase a boat or incur some other major expense for the year surveyed. Source: Harcharek, 1995

Table III.C.3-9
Nuiqsut 1993 Subsistence-Harvest Summary for Marine Mammals, Terrestrial Mammals, Fish, and Birds

	Total Number Harvested	Edible Pounds Harvested: Total	Edible Pounds Harvested: Household Harvest Mean	Edible Pounds Harvested: Per capita
Marine Mammals				
Total Marine Mammals	113	85,216	936.44	236.01
Bowhead Whale	3	76,900	845.12	213.00
Belukha Whale	0	0	0.00	0.00
Walrus	0	0	0.00	0.00
Polar Bear	1 *	0	0.00	0.00
Bearded Seal	6	1,033	11.35	2.86
Ringed Seal	98	7,277	79.96	20.15
Spotted Seal	4 *	0	0.00	0.00
Terrestrial Mammals				
Large Land Mammals	691	87,306	959.40	241.80
Brown Bear	10 *	734	8.06	2.03
Caribou	672	82,169	902.95	227.57
Moose	9	4,403	48.38	12.19
Muskox	0	0	0.00	0.00
Dall Sheep	0	0	0.00	0.00
Small Land Mammals/Furbearers	599 ¹	84	0.92	0.23
Arctic Fox	203	0	0.00	0.00
Red Fox	63	0	0.00	0.00
Marmot	0	0	0.00	0.00
Mink	0	0	0.00	0.00
Parka Squirrel	336	84	0.92	0.23
Weasel	10	0	0.00	0.00
Wolf	31	0	0.00	0.00
Wolverine	19	0	0.00	0.00
Fishes				
Total Fish	71,897	90,490	994.39	250.62
Total Salmon	272	1,009	11.08	2.79
Total Nonsalmon	71,626	89,481	983.30	247.83
Smelt	304	42	0.46	0.12
Cod	62	7	0.07	0.02
Burbot	1,416	5,949	65.37	16.48
Char	618	1,749	19.22	4.84
Grayling	4,111	4,063	44.65	11.25
Total Whitefish	64,711	77,671	853.53	215.12
Cisco	51,791	34,943	383.99	96.79
Arctic Cisco	45,237	31,666	347.97	87.72
Least Cisco	6,553	3,277	36.02	9.08
Birds				
Total Birds and Eggs	3,558	4,321	47.53	11.98
Migratory Birds	2,238	3,547	38.98	9.82
Ducks	773	1,152	12.66	3.19
Eider	662	1,054	11.61	2.91
Oldsquaw	79	52	0.64	0.17
Geese	1,459	2,314	25.43	6.41
Brant	296	316	3.51	0.89
Canada Geese	591	830	9.11	2.30
White Fronted	455	1,092	12.00	3.02
Swan	7	73	0.80	0.20
Ptarmigan	973	681	7.48	1.89
Bird Eggs	346	104	1.14	0.29

Number of households in the sample = 62; number of households in the community = 91.
Source: ADF&G Community Profile Database 1995b. Footnotes: *Not eaten. ¹Some not eaten.

and some large rainbow smelt also are harvested, but only in low numbers (George and Kovalsky, 1986; George and Nageak, 1986). A fish identified as "spotted least cisco" also has been harvested. This fish is not identified by Morrow (1980) but may be a resident form of least cisco (George and Kovalsky, 1986). Weekend fishing for burbot and grayling occurs at Itkillikpaat, 6 mi from Nuiqsut (George and Nageak, 1986; ADF&G, 1995b).

The summer catch in 1985 totaled about 19,000 lb of mostly broad whitefish; in the fall, approximately 50,000 lb of fish were caught, for an annual per capita catch of 244 lb; some of this catch was shipped to Barrow (Craig, 1987). A 1985 ADF&G subsistence survey estimated the edible pounds of all fish harvested at 176.13 lb per capita (44.1% of the total subsistence harvest; ADF&G, 1993a). In 1986, there was a reduced fishing effort in Nuiqsut, and the fall harvest was only 59 percent of that taken in 1985 (Craig, 1987). In a 1993 ADF&G subsistence survey, the estimate for edible pounds of all fish harvested had risen to 250.62 lb per capita (33.7% of the total subsistence harvest; ADF&G, 1995b). A subsistence-harvest survey conducted by the NSB DWM covering the period from July 1994 to June 1995 reported that the subsistence-fish harvest provided 25 percent of the total subsistence harvest (see Table III.C.3-10; Brower and Opie, 1997).

Fish are eaten fresh or frozen; salmon also may be split and dried. Because of their important role as an abundant and stable food source, and as a source of fresh food during the midwinter months, fish are shared at Thanksgiving and Christmas feasts and given to relatives, friends, and community elders. Because it often involves the entire family, fishing serves as a strong social function in the community, and most Nuiqsut families (80% of all households in 1993) participate in some fishing activity (ADF&G, 1995b).

(h) Marine and Coastal Birds: Waterfowl and coastal birds are a subsistence resource that has been growing in importance since the mid-1960's. Birds are harvested year-round, with peak harvests in May to June and September to October (Fig. III.C.3-11). The most important species for Nuiqsut

Table III.C.3-10
Subsistence Harvest by Month for Nuiqsut, July 1, 1994, to June 30, 1995

	1994						1995						Total	Est. Total
Item	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	71 HH's*	83 HH's
Arctic Char	0	8	0	0	0	0	0	0	0	0	0	0	8	8
Arctic Cisco[1]	0	0	37	5.737	2.400	1.050	262	0	0	0	0	0	9.486	9.842
Broad Whitefish	1.535	25	75	855	500	0	0	0	0	0	0	130	3.120	3.237
Burbot	0	0	0	9	76	3	0	0	0	0	0	0	88	91
Fish Unidentified	0	0	0	0	0	0	0	0	0	0	0	75	75	78
Grayling	0	24	225	110	84	0	0	0	0	0	0	2	445	462
Humpback Salmon	10	0	0	0	0	0	0	0	0	0	0	0	10	10
Humpback Whitefish[1]	0	0	0	150	25	0	0	0	0	0	0	0	175	182
Least Cisco	0	0	0	0	0	750	0	0	0	0	0	0	750	778
Northern Pike	0	0	0	0	0	0	0	0	0	0	0	18	18	19
Whitefish Unidentified	0	0	0	50	425	0	0	0	0	0	0	0	475	493
Caribou	63	32	6	80	13	4	9	5	13	7	2	15	249	258
Moose	1	1	1	1	0	0	1	0	0	0	0	0	5	5
Wolf	0	0	0	0	1	1	3	0	12	1	0	0	18	19
Wolverine	0	0	0	0	1	1	2	1	1	2	0	0	8	8
Arctic Fox	0	0	0	0	0	1	1	1	3	0	0	0	6	6
Fox Unidentified	0	0	0	0	4	0	0	0	0	0	0	0	4	4
Red Fox	0	0	0	0	0	1	1	1	1	1	0	0	5	5
Polar Bear	0	0	0	0	1	0	0	0	0	0	0	0	1	1
Tundra Swan	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Geese Unidentified	0	0	0	0	0	0	0	0	0	0	409	48	457	474
Eider Unidentified	0	0	0	0	0	0	0	0	0	0	50	40	90	93
Ptarmigan	0	0	0	0	0	0	0	0	0	33	23	0	56	58
Sandhill Crane	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Ringed Seal	2	10	0	0	0	0	0	0	0	6	0	5	23	24
Salmonberries (gal)	0	9	0	0	0	0	0	0	0	0	0	0	9	9
Cranberries (gal)	0	0.5		0	0	0	0	0	0	0	0	0	0.5	1
Blueberries (gal)	0	2.5		0	0	0	0	0	0	0	0	0	2.5	3
Blackberries (gal)	0	0.5		0	0	0	0	0	0	0	0	0	0.5	1

*Households Source Brower and Opie, 1997a,b

[1] The harvest of arctic cisco and humpback whitefish is under represented one household provided evidence of a significant but unquantifiable harvest by saying that "sled loads" were harvested "every couple of days during October and November."

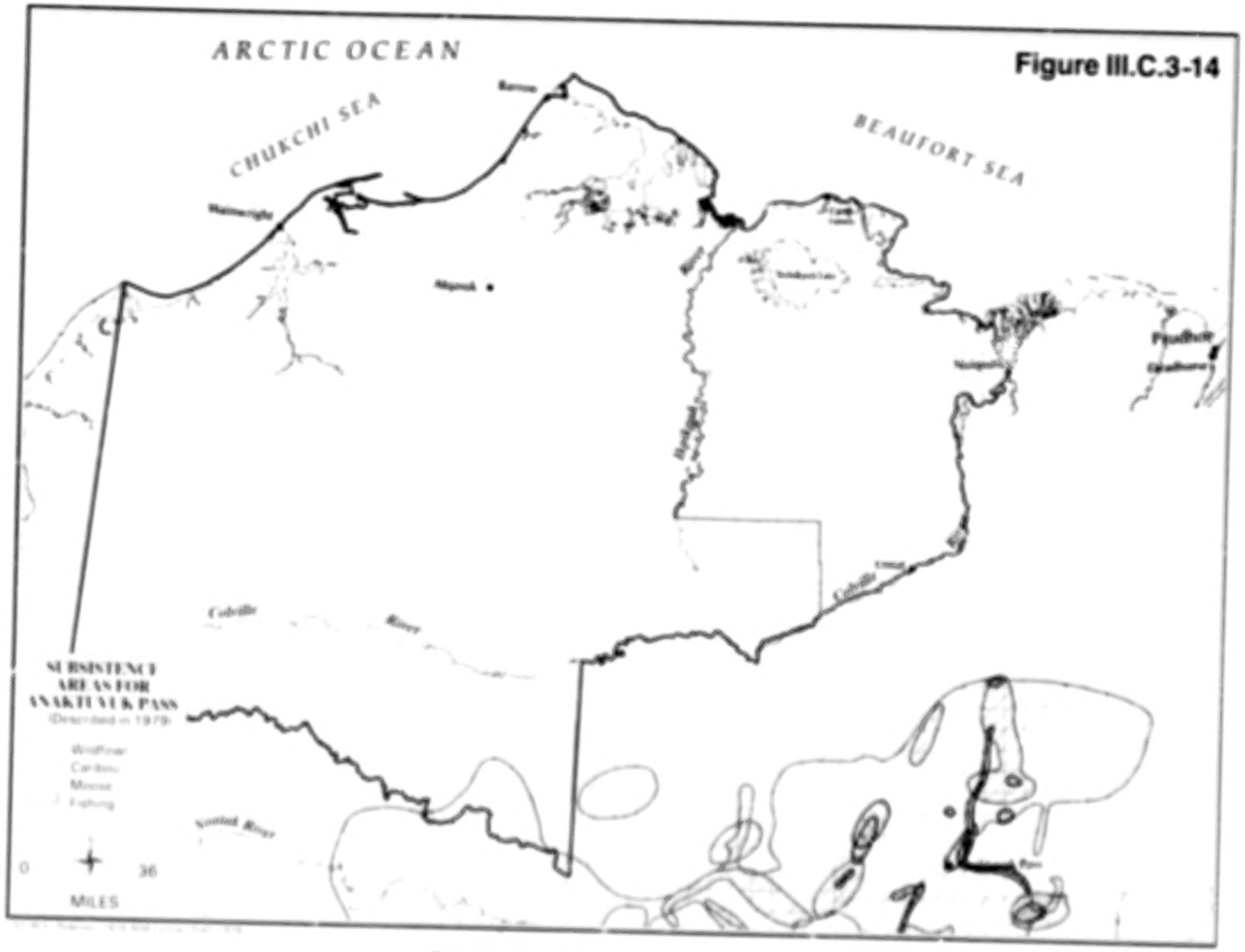
hunters are the Canada and white-fronted goose, brant, eiders, and oldsquaw, pintail ducks and the snow goose are harvested in low numbers. Upland birds are harvested, but the ptarmigan is the only one hunted extensively (see Tables III.C.3-9 and III.C.3-10, ADF&G, 1993a, 1995b, Brower and Opie, 1997). Recent data indicated the subsistence-bird harvest provided 4 percent of the total subsistence harvest (Brower and Opie, 1997). Waterfowl hunting occurs mostly in the spring, beginning in June, and continues throughout the summer and probably into September. In the summer and early fall, such hunting usually occurs as an adjunct to other subsistence activities, such as checking fish nets. Nuiqsut hunters harvest brant in August and early September.

(ii) **Moose**: Moose are harvested from July to October by boat on the Colville (upriver from Nuiqsut), Chandler, and Itkillik rivers (Fig. III.C.3-11). When water levels become too low in fall for access to prime moose-harvest areas, the hunt is discontinued as moose are too large and difficult to handle by Nuiqsut hunters on snowmachines (Impact Assessment, Inc., 1990c). In 1985, hunters from 40 households surveyed reported a harvest of seven moose (out of a total 76 households) (ADF&G, 1993a). In 1993, 62 households surveyed managed to harvest nine moose (out of a total 91 households) (see Tables III.C.3-9 and III.C.3-10, ADF&G, 1995b, Brower and Opie, 1997). A subsistence-harvest survey conducted by the NSB DW/M covering the period from July 1994 to June 1995 reported five moose harvested or 21 percent of the total edible pounds harvested that season (Brower and Opie, 1997).

Figures III.C.3-12 and III.C.3-13 indicate recent trends in Nuiqsut household consumption of subsistence foods and expenditures on subsistence activities (Harcharek, 1995).

(4) **Other Villages**: Other communities within or adjacent to the NPR-A are the Chukchi Sea villages of Point Lay and Wainwright to the west and the inland

Figure III.C.3-14



SUBSISTENCE AREAS FOR ANAKTUVUK PASS
(Described in 1979)

BEST COPY AVAILABLE

BLANK PAGE

community of Anaktuvuk Pass to the south and east. Subsistence-harvest areas for these communities are not within or adjacent to the planning area, although recent research indicates that movement by the Teshekpuk Lake Caribou Herd does bring the herd into the traditional subsistence-harvest areas of the communities of Wainwright and Point Lay. Historically, Anaktuvuk Pass caribou hunters have ranged to the southerly boundary of the planning area; and movement by the Teshekpuk Lake herd could bring it into the harvest area of Anaktuvuk Pass subsistence hunters as well (Fig. III.C.3-14).

(5) Subsistence Access Routes: In the often featureless plain that characterizes much of the planning area during winter, topographic features such as river valleys, shorelines, large lakes, and the Beaufort Sea coastline, as well as geological formations such as pingos are crucial to the Inupiat in determining safe routes to subsistence-hunting sites. The Inupiat are skilled hunters with several millennia of experience in dealing with extreme terrain and weather conditions. During periods of extreme weather, river valleys and shore banks offer some measure of protection to the traveler. If the weather is not too extreme and the river valley sufficiently well defined, a traveler can continue the journey. During good weather, Inupiat hunters can steer off such features as meandering river bends that they are familiar with and transit between river drainages in the pursuit of game. Although fluvial features may define movement corridors, they should be considered as points from which general cross-country movement can and does occur.

In 1973, the NSB re-established the community of Nuiqsut, in this way, reasserting their claim to a traditional Inupiaq site and subsistence harvest area. The Colville River valley and adjacent coastal lowlands comprise a traditional Inupiaq harvest zone that had been actively inhabited until the 1940's. The Colville River historically has been used by the coastal Inupiat as a link to the Interior (see Fig. III.C.3-16, Historical Subsistence Access Routes.) Beyond its function as an interregional link, the Colville River and its tributaries provide the people of Nuiqsut with an area rich in hunting, fishing, and trapping opportunities. Moose are hunted along the length of the river while summer fishing occurs in the delta.

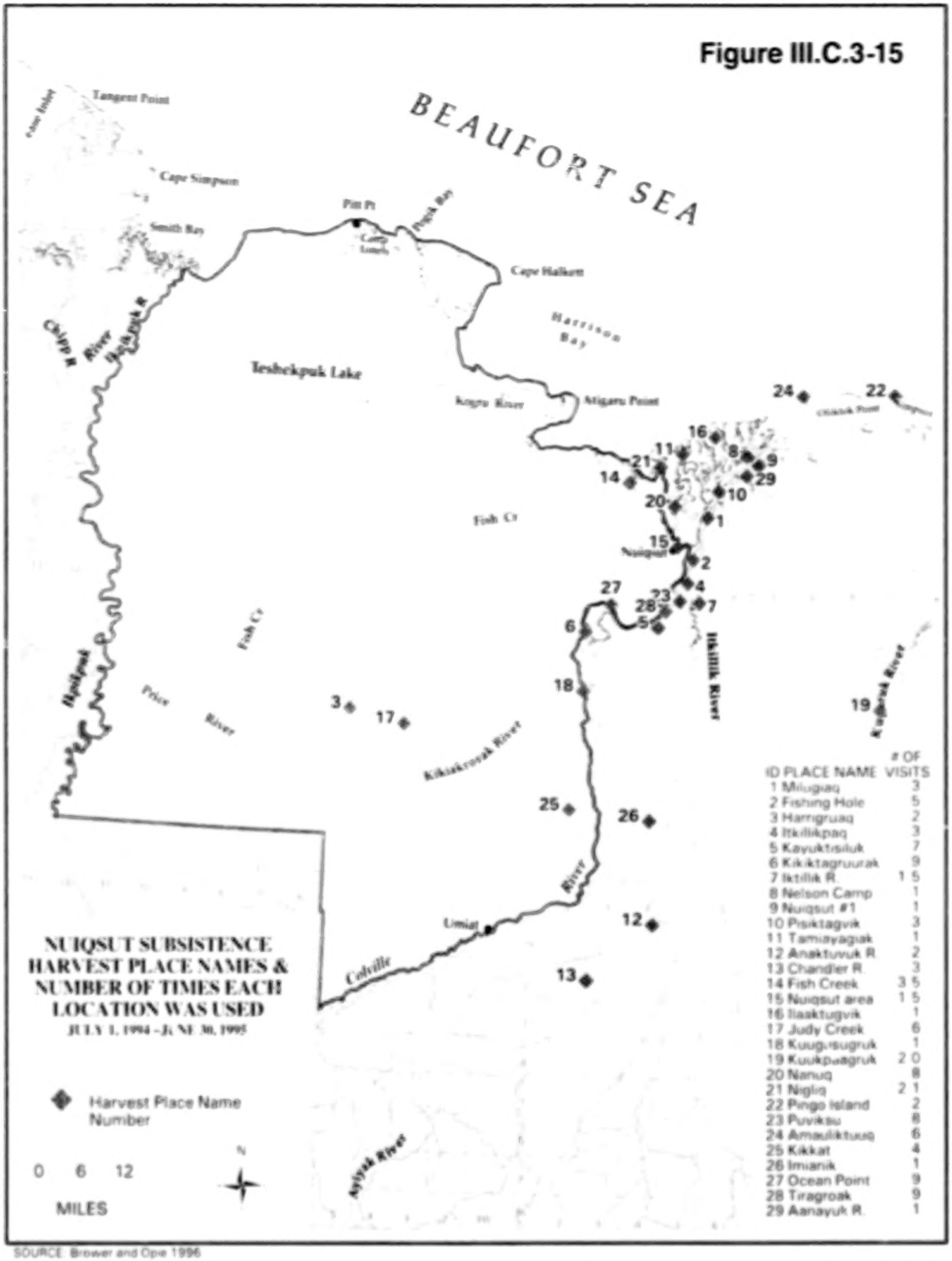
Winter fishing occurs around the village and inland along Fish Creek. Caribou are taken throughout the range of Nuiqsut's coastal subsistence-harvest area and also along the southern reaches of the Itkillik River well (Figs. III.C.3-1 and III.C.3-10). The principal watercourses west of the Colville that are use in the pursuit of subsistence resources are the Ublutuoch River and Judy and Fish creeks. To the east of the Colville, hunters use the Miluveach and Itkillik rivers. Along the coastal plain, Nuiqsut hunters seem to favor hunting in the area between the community and Teshekpuk Lake. The lake is approximately 85 mi from Nuiqsut, and subsistence hunters often circumnavigate it before returning home. Figure III.C.3-15 shows subsistence-harvest locations used and the number of times visited by Nuiqsut hunters for the period July 1994 to June 1995 (Brower and Opie, 1997).

While hunting near Teshekpuk Lake, Nuiqsut hunters often encounter hunters from Barrow, which has a large subsistence-hunting zone, the largest on the North Slope (Figs. III.C.3-1 and III.C.3-2). From a review of Figure III.C.3-16 (Historical Subsistence Access Routes), it is believed that Barrow hunters use all these routes and more. Figures III.C.3-17 and III.C.3-18 indicate subsistence-harvest sites and cabin and fixed-camp locations identified in Braund's 3-year Barrow subsistence study (Stephen R. Braund and Associates and UAA, ISER, 1993). Atqasuk is used as a base camp for Barrow hunters as they hunt toward and into the foothills of the Brooks Range. The Meade, Topagoruk, and Ikpikpuk rivers are used for navigation into the Interior. The Ikpikpuk River route is particularly important, because it lies on the boundary of the planning area. Barrow hunters guide along the Beaufort Sea shoreline, using the smooth ice and the landfast-ice zone to reach Teshekpuk Lake. They often circumnavigate the lake and will often proceed to Nuiqsut to visit family members (Tremont, 1987; 1997, pers. comm.). Atqasuk subsistence hunters primarily use the Meade, Inaru, Topagoruk, and Chipp river drainages for caribou hunting and for fishing, but the extent of their subsistence-harvest area extends farther west toward the Chukchi coast and east toward the Oumalik and Ikpikpuk rivers (USDOI, BLM, 1978c; Schneider, Pedersen, and Libbey, 1980). Figure III.C.3-19 shows subsistence-harvest locations used and the number of times visited by Atqasuk hunters for the period July 1994 to June 1995 (Opie, Brower, and Bates, In prep.).

4. Sociocultural Systems: The topic of sociocultural systems encompasses the social organization and cultural values of the society. This section provides a profile of the sociocultural systems that characterize the communities near the planning area that might be affected by this action—Barrow, Atqasuk, and Nuiqsut. All of these communities are within the NSB. The ethnic, sociocultural, and socioeconomic makeup of the communities on the North Slope is primarily Inupiaq. Sociocultural systems of the North Slope Inupiat are described and discussed in detail in the Beaufort Sea Sale 97 FEIS (USDOI, MMS, 1987a Sec. III.C.2), the Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1987b Sec. III.C.3), the Beaufort Sea Sale 124 FEIS (USDOI, MMS, Alaska OCS Region,1990 Sec. III.C.2), and the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a). The following summary is augmented by additional material, as cited, and the referenced description sections are incorporated by

BLANK PAGE

Figure III.C.3-15



NUIQSUT SUBSISTENCE HARVEST PLACE NAMES & NUMBER OF TIMES EACH LOCATION WAS USED

JULY 1, 1994 - JUNE 30, 1995

ID	PLACE NAME	# OF VISITS
1	Milugiaq	3
2	Fishing Hole	5
3	Harrigruaq	2
4	Itkillikpaq	3
5	Kayuktisiluk	7
6	Kikiktagruurak	9
7	Iktillik R.	15
8	Nelson Camp	1
9	Nuiqsut #1	1
10	Pisiktagvik	3
11	Tamiayagiak	1
12	Anaktuvuk R.	2
13	Chandler R.	3
14	Fish Creek	35
15	Nuiqsut area	15
16	Ilaaktugvik	1
17	Judy Creek	6
18	Kuugusugruk	1
19	Kuukpaagruk	20
20	Nanuq	8
21	Nigliq	21
22	Pingo Island	2
23	Puviksu	8
24	Amauliktuuq	6
25	Kikkat	4
26	Imianik	1
27	Ocean Point	9
28	Tiragroak	9
29	Aanayuk R.	1

SOURCE: Brower and Opie 1996

BEST COPY AVAILABLE

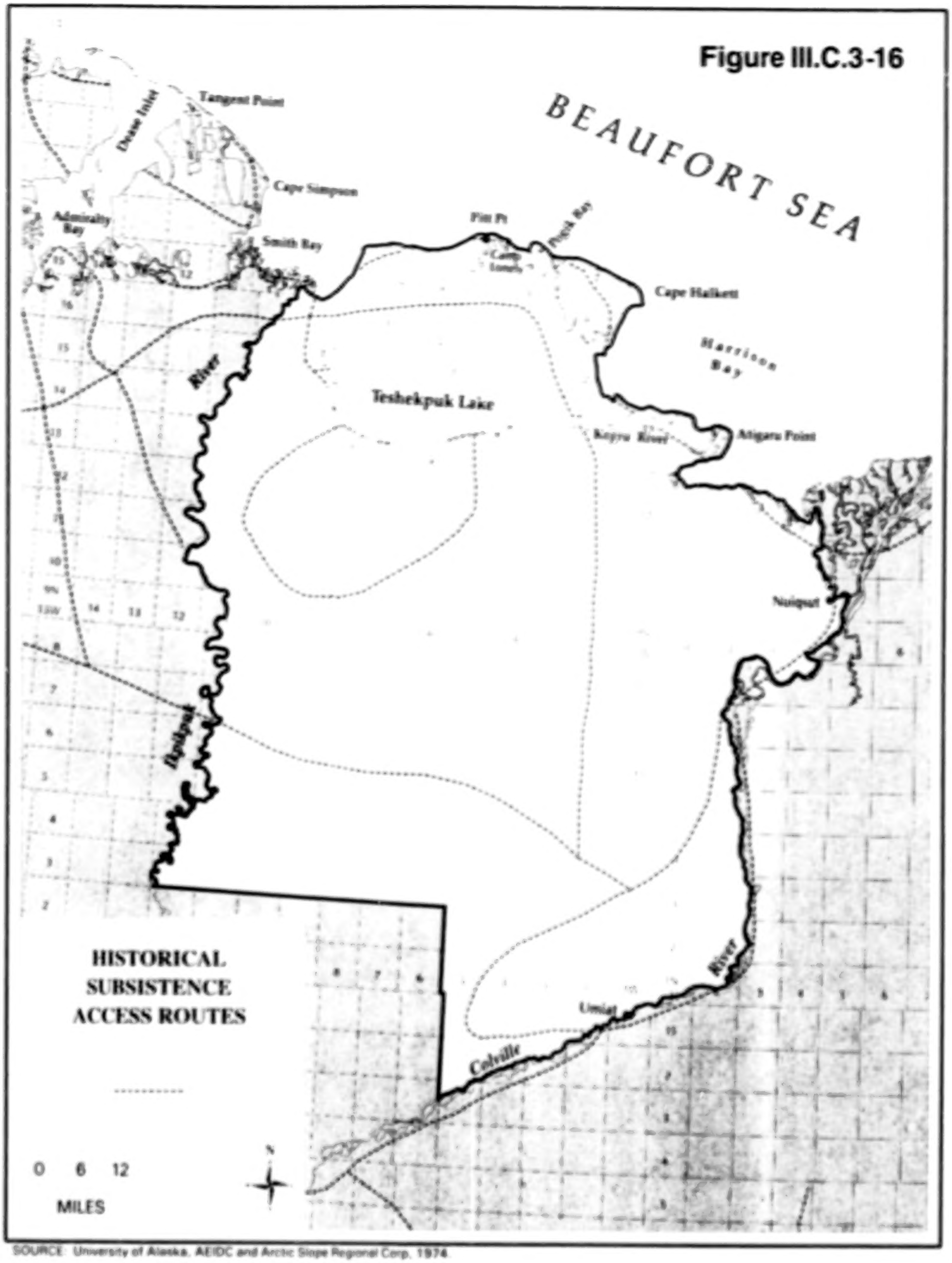


Figure III.C.3-16

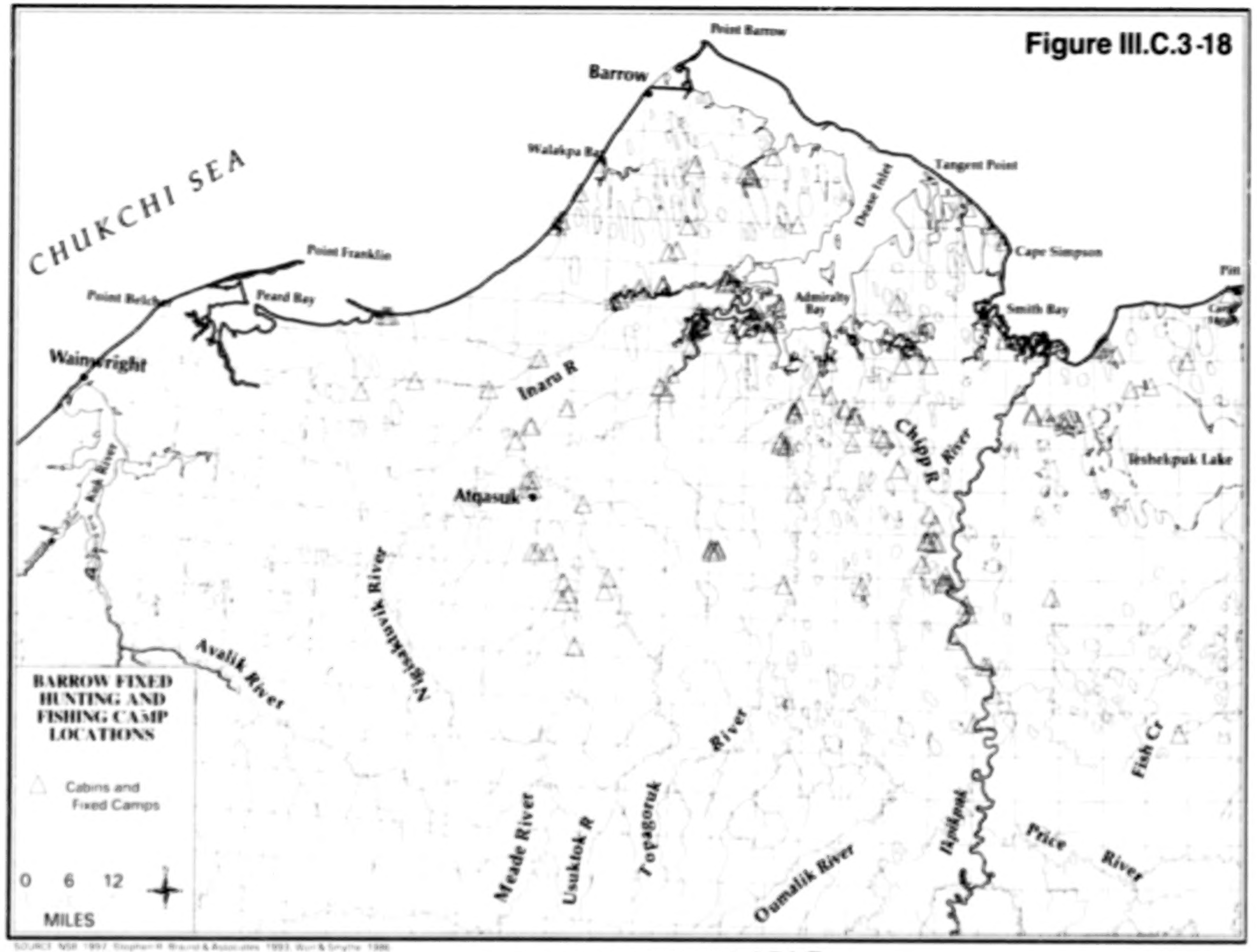
HISTORICAL SUBSISTENCE ACCESS ROUTES

SOURCE: University of Alaska, AEIDC and Arctic Slope Regional Corp. 1974

BEST COPY AVAILABLE

228

Figure III.C.3-18



SOURCE: NSB 1997; Stephen R. Braund & Associates 1993; Burr & Smythe 1986

BEST COPY AVAILABLE

229

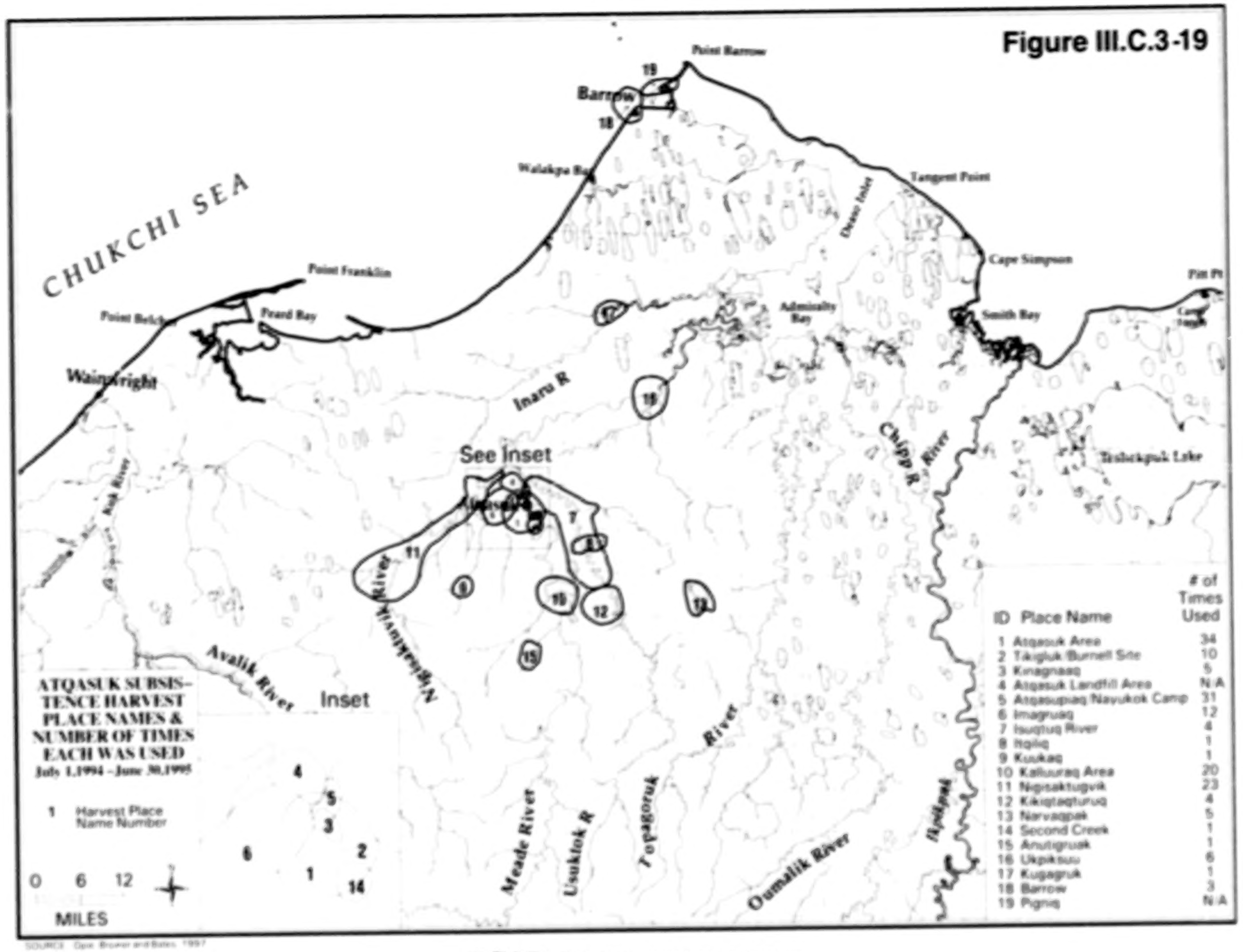


Figure III.C.3-19

ATQASUK SUBSISTENCE HARVEST PLACE NAMES & NUMBER OF TIMES EACH WAS USED
July 1,1994 – June 30,1995

1 Harvest Place Name Number

ID	Place Name	# of Times Used
1	Atqasuk Area	34
2	Tikigluk/Burnell Site	10
3	Kinagnaaq	5
4	Atqasuk Landfill Area	N/A
5	Atqasupiaq/Navukok Camp	31
6	Imagruaq	12
7	Isuqtuq River	4
8	Itqiliq	1
9	Kuukaq	1
10	Kalluuraq Area	20
11	Nigisaktugvik	23
12	Kikiqtaqturuq	4
13	Narvaqpak	5
14	Second Creek	1
15	Anutigruak	1
16	Ukpiksuu	6
17	Kugagruk	1
18	Barrow	3
19	Pigniq	N/A

SOURCE: Opie, Brower and Bates, 1997

BEST COPY AVAILABLE

BLANK PAGE

In the period from 1975 to 1985, Barrow experienced extensive social and economic transformations. The NSB CIP stimulated a boom in the Barrow economy and an influx of non-Natives to the community; between 1980 and 1985, Barrow's population grew by 35.6 percent (Kevin Waring Associates, 1989). Inupiat women entered the labor force in the largest numbers ever and achieved positions of political leadership in the newly formed institutions. The proportion of Inupiat women raising families without husbands also increased during this period. The extended family, operating through interrelated households, is salient in community social organization (Worl and Smythe, 1986). During this same period, the social organization of the community became increasingly diversified with the proliferation of formal institutions and the large increase in the number of different ethnic groups. Socioeconomic differentiation is not new in Barrow. During the commercial-whaling period and the reindeer-herding period, there were influxes of outsiders and significant shifts in the economy. Other fluctuations have occurred during different economic cycles (fur trapping, U.S. Navy and arctic contractors' employment, the CIP boom, and periods of downturn [Worl and Smythe, 1986]). As a consequence of the changes it already has sustained, Barrow may be more capable of absorbing additional changes as a result of development in the planning area than would a smaller, homogeneous Inupiat community.

(2) Atqasuk: Atqasuk is a small, predominantly Inupiat community (92% in 1990 [USDOC, Bureau of the Census, 1991]) located inland from the Arctic Ocean on the Meade River about 60 mi south of Barrow. In 1995, ADOL estimated there were 233 residents in Atqasuk (ADOL figures as cited in ADF&G, 1995b). Atqasuk is located to the west of the planning area, and the eastern edge of its subsistence-use area approaches the western boundary of the planning area.

(3) Nuiqsut: Nuiqsut is located on the west bank of the Nechelik Channel of the Colville River Delta, about 25 mi from the Arctic Ocean and approximately 150 mi southeast of Barrow. In 1995, ADOL estimates were 410 residents for Nuiqsut (ADOL figures from ADF&G, 1995b). Nuiqsut, one of three abandoned Inupiat villages in the North Slope region identified in the ANCSA, was resettled in 1973 by 27 families from Barrow. Much of Nuiqsut's subsistence use occurs within the proposed planning area, including many of its subsistence-harvest areas for caribou, fish, and birds.

c. Social Organization: The social organization of communities near the planning area is strongly kinship oriented. Kinship formed "the axis on which the whole social world turned" (Burch, 1975). Historically, households were composed of large, extended families, and communities were kinship units. Today, there is a trend away from the extended-family household because of increases in mobility, availability of housing, and changes in traditional kinship patterns. However, kinship ties in Inupiat society continue to be important and remain a central focus of the social organization.

The social organization of the North Slope Inupiat encompasses not only households and families but wider networks of kinspeople and friends. These various types of networks are related through various overlapping memberships and also are embedded in those groups that are responsible for hunting, distributing, and consuming subsistence resources (Burch, 1970). An Inupiat household on the North Slope may contain a single individual or group of individuals who are related by marriage or ancestry. The interdependencies that exist among Inupiat households differ markedly from those found in the U.S. as a whole. In the larger non-Inupiat society, the demands of wage work emphasize a mobile and prompt workforce. While modern transportation and communication technologies allow for contact between parents, children, brothers, sisters, and other extended-family members, more often than not independent nuclear households (father, mother, and children) or conjugal pairs (childless couples) form independent "production" units that do not depend on extended-family members for the day-to-day support of food, labor, or income. A key contrast between non-Native and Inupiat cultures occurs in their differing expectations of families—the Inupiat expect and need support from extended-family members on a day-to-day basis.

Associated with these differences, the Inupiat hold unique norms and expectations about sharing. Households are not necessarily viewed as independent economic units; and giving, especially by successful community members (e.g., hunters), is regarded as an end in itself, although community status and esteem accrue to the generous. Kinship ties are strengthened through sharing and exchanging of subsistence resources (Nelson, 1969; Burch, 1971; Worl, 1979; ACI, Courtnage, and Braund, 1984; Luton, 1985; Chance, 1990).

d. Cultural Values: Traditionally, Inupiat values centered on the Inupiat's close relationship with natural resources, specifically game animals. The Inupiat also had a close relationship to the supernatural with specific beliefs in animal souls and beings who controlled the movements of animals. Other values included an emphasis on the community and its needs and its support of other individuals. The Inupiat respected persons who were generous, cooperative, hospitable, humorous, patient, modest, and industrious (Lantis, 1959; Milan, 1964; Chance, 1966, 1990). Although there have been substantial social, economic, and technological changes in

Inupiat lifestyle, subsistence continues to be the core or central organizing value of Inupiat sociocultural systems in the planning area. The Inupiat remain socially, economically, and ideologically loyal to their subsistence heritage. Indeed, "most Inupiat still consider themselves primarily hunters and fishermen" (Nelson, 1969). This refrain is repeated again and again by the residents of the North Slope (Kruse et al., 1983; ACI, Courtnage, and Braund, 1984; Impact Assessment, Inc., 1990a,b; USDOI, MMS, 1994). Task groups still are organized to hunt, gather, and process subsistence foods. Cooperation in hunting and fishing activities also remains an integral part of Inupiat life. With whom one cooperates is a major component of the definition of significant kin ties (Heinrich, 1963). Large amounts of subsistence foods are shared within the community. To whom one gives and from whom one receives also are major components of what makes up significant kin ties (Heinrich, 1963; ACI, Courtnage, and Braund, 1984).

On the North Slope, "subsistence" is much more than an economic system; the hunt, the sharing of products of the hunt, and the beliefs surrounding the hunt tie families and communities together, connect people to their social and ecological surroundings, link them to their past, and provide meaning for the present. Generous hunters are considered good men. Good hunters are often respected leaders. Good health comes from a diet of products of the hunt. Young hunters still give their first game to the community elders. To be generous brings future success. These are but some of the ways in which subsistence and beliefs about subsistence join with sociocultural systems.

The cultural value placed on kinship and family relationships is apparent in the sharing, cooperation, and subsistence activities that occur in Inupiat society, as discussed above. However, cultural value also is apparent in the patterns of residence, reciprocal activities, social interaction, adoption, political affiliations (some families will dominate one type of government administration, e.g., the village corporation), employment, sports activities, and membership in voluntary organizations (Mother's Club, Search and Rescue, etc.) (ACI, Courtnage, and Braund, 1984).

Bowhead whaling remains at the center of Inupiat spiritual and emotional life; it embodies the values of sharing, association, leadership, kinship, arctic survival, and hunting prowess (see Bockstoce et al., 1979; ACI, Courtnage, and Braund, 1984). Barrow resident Beverly Hugo, testifying at the public hearings for Beaufort Sea Sale 124, summed up Inupiaq cultural values this way:

> . . .these are values that are real important to us, to me; this is what makes me who I am. . .the knowledge of the language, our Inupiat language, is a real high one; sharing with others, respect for others. . .and cooperation; and respect for elders; love for children; hard work; knowledge of our family tree; avoiding conflict; respect for nature; spirituality; humor; our family roles. Hunter success is a big one, and domestic skills, responsibility to our tribe, humility. . .These are some of the values. . .that we have. . .that make us who we are, and these values have co-existed for thousands of years, and they are good values. . (USDOI, MMS, 1990).

The ramifications of the whale hunt are more than emotional and spiritual. The organization of the crews does much to delineate important social and kin ties within communities and to define community-leadership patterns as well. The structured sharing of the whale helps determine social relations both within and between communities (Worl, 1979; ACI, Courtnage, and Braund, 1984; Impact Assessment, Inc., 1990a). Structured sharing also holds true for caribou hunting, fishing, and other subsistence pursuits. In these communities, the giving of meat to elders does more than feed old people; it bonds giver and receiver together, joins them to a living tradition, and draws them into their community.

Today, this close relationship between the spirit of a people, their social organization, and the cultural value of subsistence hunting may be unparalleled when compared with other American energy-development situations. The Inupiat's continuing strong dependence on subsistence foods, particularly marine mammals and caribou, creates a unique set of potential effects from onshore and offshore oil development on the social and cultural system. Barrow resident Daniel Leavitt articulated these concerns this way during the 1990 public hearing for Beaufort Sea Sale 124: ". . .as I have lived in my Inupiat way of livelihood, that's the only. . .thing that drives me on is to get something for my family to fill up their stomachs from what I catch" (USDOI, MMS, 1990).

At Public Scoping Meetings in Barrow, Atqasuk, Anchorage, Fairbanks, and Nuiqsut during March and April 1997, the Native community again expressed universal concern for protecting subsistence resources (especially the disturbance to caribou from seismic activity) and access to those resources, and the need to better identify and protect important subsistence-harvest areas, especially the Teshekpuk Lake caribou calving area, the Colville Delta, moose along the Colville River, and fishing resources at Teshekpuk Lake and on the Ikpikpuk and Fish Creek drainages. Testifiers at all five locations stressed the need to collect and use traditional Native knowledge in the EIS assessment process and in the final decision process. The need to settle land selections and allotment issues before leasing could occur was stressed in Atqasuk and

Nuiqsut (Barrow, Atqasuk, Anchorage, Fairbanks, and Nuiqsut Public Scoping Meeting Transcripts, NPR-A IAP/EIS, March 17, 18, 25, 27 and April 10, 1997, USDOI, BLM, 1997).

At all five scoping meetings, the need to address cumulative impacts was stressed again and again, mainly because of impacts from development that have reduced subsistence access to and use of the area around Prudhoe Bay. The point was made at each meeting that the incremental development in and around Prudhoe Bay has created through time a situation where, collectively, these projects have generated cumulative impacts. This collective development can be assessed only through a viable monitoring regime—something that has never been established by the industry or the Federal and State agencies involved. One suggestion that was repeatedly made and reiterated again at the April 16 to 18, 1997, NPR-A Symposium (USDOI, MMS, 1997) was a need for an ongoing subsistence-oversight panel composed of Federal, State, Native, and oil-industry interests that would address these concerns and the issue of instituting an ongoing subsistence-monitoring program (USDOI, MMS, 1997).

e. Institutional Organization of the Communities: The NSB provides most government services for the communities that might be affected by activity in the planning area. These services include public safety, public utilities, fire protection, and some public-health services. Future fiscal and institutional growth is expected to slow because of economic constraints on direct Inupiat participation in oil-industry employment and growing constraints on the Statewide budget, although NSB revenues have remained healthy and its own permanent fund account continues to grow as does its role as primary employer in the region (Kruse et al., 1983; Harcharek, 1992, 1995). The ASRC, formed under ANCSA, runs several subsidiary corporations. Most of the communities also have a village corporation, a Traditional Village or Indian Reorganization Act (IRA) Village Council, and a city government. The IRA's and village governments have not provided much in the way of services, but village corporations have made services contributions.

f. Other Issues: Other issues important to an analysis of sociocultural systems are those that will affect or are already affecting (i.e., cumulative impacts) Inupiat society. Sections III.C.1 of the MMS Sale 97, Sale 124, and Sale 144 FEIS's detail issues about fiscal and institutional growth in the NSB, changes in employment, increases in income, decreases in Inupiaq fluency, rising crime rates, and substance abuse (USDOI, MMS, 1987a, 1990, 1996a) and also discuss NSB's fiscal and institutional growth. These discussions, augmented here by additional material, as cited, are incorporated by reference. In addition, Smythe and Worl (1985) and Impact Assessment, Inc. (1990a) detail the growth and responsibilities of local governments.

The baseline of the present sociocultural system includes change and strain. The very livelihood and culture of North Slope residents come under increasingly close scrutiny, regulation, and incremental alteration. This increase of stresses on social well-being and on cultural integrity and cohesion comes at a time of economic well-being and has not been challenged as significantly as once thought by the decline in CIP funding from the State of Alaska. This has come about mostly through the dramatic growth of the Borough's own permanent fund and the NSB taking on more of the burden of its own capital improvement as well as being the largest employer of local residents.

5. Land Uses and Coastal Zone Management:

a. Land Ownership and Uses:

(1) Land Ownership: The majority of land ownership within the planning area is under Federal jurisdiction, with the remaining lands limited primarily to Native entities. The majority of these are located around the village of Nuiqsut (Fig. III.C.5.a-1). The State of Alaska owns approximately 1,450 acres at the Umiat airport.

(a) Federal Jurisdiction: Executive Order 3797, signed by President Warren G. Harding on February 27, 1923, reserved 23.7 million acres and established the Naval Petroleum Reserve #4 (NPR-4). This area was reserved for oil and gas development for Naval defense purposes. The National Petroleum Reserves Production Act of 1976 (P.L. 94-258) (NPRPA) transferred jurisdiction of NPR-4 to the Secretary of the Interior and renamed it the National Petroleum Reserve of Alaska (NPR-A). The planning area boundary encompasses 4.6 million ac, of which 4,511,753 ac are under federal jurisdiction.

The planning area boundary extends to the northern boundary of the NPR-A, generally following the shoreline but extending offshore to encompass certain bays and lagoons. The lands beyond this northern boundary, extending from mean low tide out for 3 mi, are owned by the State of Alaska under the Federal Submerged Lands Act. Decisions on the use of these State lands, including decisions on oil and gas leasing, are made by the State of Alaska, DNR.

The ownership of the land in those bays and lagoons that are within the NPR-A boundary, but tidally influenced, were disputed between the State and Federal Government.

The U.S. Supreme Court in the *United States v. State of Alaska* (Orig. 84), a case referred to as Dinkum Sands, ruled in June of 1997 that these lands are federally owned because the land was retained by the U.S. Congress at Statehood (1959). These offshore lands within the planning area could be made available to oil and gas leasing, along with onshore Federal lands.

(b) **Native Allotments**: The Native Allotment Act of 1906, as amended, allowed an Alaskan Indian and or Eskimo to receive up to 160 acres of vacant and unappropriated land. Applicants had to show use and occupancy of lands selected.

The majority of the Native allotments within the NPR-A were closed to selection prior to the passage of the ANILCA. This was a result of applicants being informed that if they relinquished their claims, the village corporations would receive ANCSA conveyances sooner, and then the corporations would reimburse the applicants for the lands relinquished. Another factor was the belief that the NPR-A lands were not available for selection under the Native Allotment Act of 1906.

With the passage of ANILCA (Sec. 905), allotments within the NPR-A were reinstated with the exception of the allotments on lands conveyed to the village corporations of Atqasuk, Barrow, or Wainwright. Section 12 of the Technical Correction Act of 1992 amended Section 905 of ANILCA to allow the allotments on lands conveyed to the corporations within the NPR-A to be reconveyed if certain conditions were met. All three villages will reconvey the Native allotments to the U.S. for certification of the Native allotment to the applicant.

Certificates of Allotments issued on lands valuable for oil and gas contain a reservation of those minerals to the U.S. It is presumed that all certificates for allotments in the planning area will contain this reservation. There are approximately 34 allotments comprising approximately 4,380 acres within the planning area. Of these, 25 are unsurveyed. Survey of these allotments has been scheduled for the 1998 field season.

(c) **Village Corporation Lands**: The ANCSA allowed the four village corporations of Atqasuk, Barrow, Nuiqsut, and Wainwright to select surface lands under Sections 12(a) and 12(b). The NPRPA reiterated the availability of lands for selection and conveyance by village corporations under the ANCSA. Section 12 of the Technical Corrections Act of 1992 allowed the villages to reconvey lands under a valid Native allotment application in exchange for an equal number of acres of additional selections. For the village of Nuiqsut, the total 12(a) and (b) entitlement is 77,014 acres. Of this figure, the village has 21,374.4 acres that they still need to select to complete their entitlement.

(d) **Regional Corporation Lands**: Within the planning area, the ASRC has 5,400 acres of surface land ownership at Cape Halkett, which was exchanged for ASRC's Kurupa Lake lands (5,332 acres) on December 9, 1981. The ASRC also has subsurface rights within the planning area, as follows.

The ANCSA did not allow the ASRC to select the subsurface estate within the NPR-A. However, Section 12(a)(1) did allow the ASRC to select the subsurface estate in equal acreage to their entitlement from lands outside the withdrawal. This was clarified by Public Land Order 5183, dated March 9, 1972, which withdrew NPR-A lands from selection of the subsurface by the regional corporation. This was reiterated again in the passage of the NPRPA that recognized the village corporations' selections of surface estate under ANCSA but did not recognize any other lands claims.

It would be 5 years before regional selections would be allowed in the NPR-A with the passage of the Appropriations Act of 1981 (P.L. 96-514). This Act authorized the Secretary of the Interior to lease lands within the NPR-A for oil and gas exploration and development. The passage of this Act allowed the implementation of Section 1431(o) of ANILCA, which provided specific legislative authority to exchange NPR-A lands contingent upon legislative direction to open the NPR-A to commercial development. This allowed the regional corporation (ASRC) to select the subsurface of village-selected lands if lands within 75 mi of the village lands were made available for commercial development. The ASRC selected the lands under the villages of Nuiqsut and Wainwright. At Nuiqsut, the ASRC will receive the subsurface of all lands conveyed to the village once their entitlement is completed.

(e) **State of Alaska**: A total of 1,450 acres at the Umiat Airport were transferred to the State of Alaska by a Quit Claim Deed on June 1, 1966 (U.S. Survey 9571).

(2) **Land Uses**:

(a) **Authorized Use**: Poor soil conditions, as found in the study area, limit the ability of BLM to entertain most land use proposals for summer operations. Permafrost underlays the entire reserve, and floodplains wetlands cover the majority of the area, reducing even further BLM's ability to allow surface activity. Some winter activities are allowed with specific restrictions on a case-by-case basis.

The activities listed below represent a sampling of long-term and short-term land use currently authorized or pending authorization within the planning area:

- Annual overland resupply moves between the various North Slope villages using track- or rolligon-equipped vehicles.
- Active and inactive DEW-Line installation locations (active, Lonely/inactive, Kogru).
- Minimum Impact Permit (3-year duration) using FLPMA include, but are not limited to, a Wildlife Observation Station at Teshekpuk Lake issued to the NSB, a paleontological dig (dinosaur bones) in the Colville River drainage at Ocean Point, and a proposed staging/storage area for the Western Geophysical Company at Inigok airstrip.
- A lease to a Native regional corporation (Cook Inlet Region; Inc. [CIRI]) for the USGS Husky logistics camp and staging area (15.5 acres) near the Lonely DEW-Line installation. The CIRI took possession of the buildings through a General Service Administration agreement.
- Numerous Special Recreation Permits within the planning area that authorize commercial sporthunting operations for up to a 5-year duration.
- Annual winter geophysical activities (seismic) by geophysical research companies throughout the planning area.
- Authorization for continued research (revegetation at well sites, climatic studies, etc.) to the BLM.
- Various communication/navigation-related authorizations (to Federal Agencies) such as Vortec sites, RACON sites, communication towers, etc.

There currently are approximately 20 authorizations for all above-listed types within the planning area. Most of these are the type that allow use for 3 to 5 years, with nothing exceeding 20 years.

(b) **Access**: There are no existing roads that link the study area with any other villages within the NPR-A. The BLM, however, has linked the villages of Barrow, Atqasuk, Wainwright, and the Kogru River (northeast of Nuiqsut) with marked trails (marking is ongoing) that are usable only during the winter. These winter trails follow but are not part of existing ANCSA Section 17(b) easements, which eventually meet with existing road networks within the various villages. The trails do not cross Native Allotments. There are no ANCSA 17(b) easements within the Nuiqsut village lands.

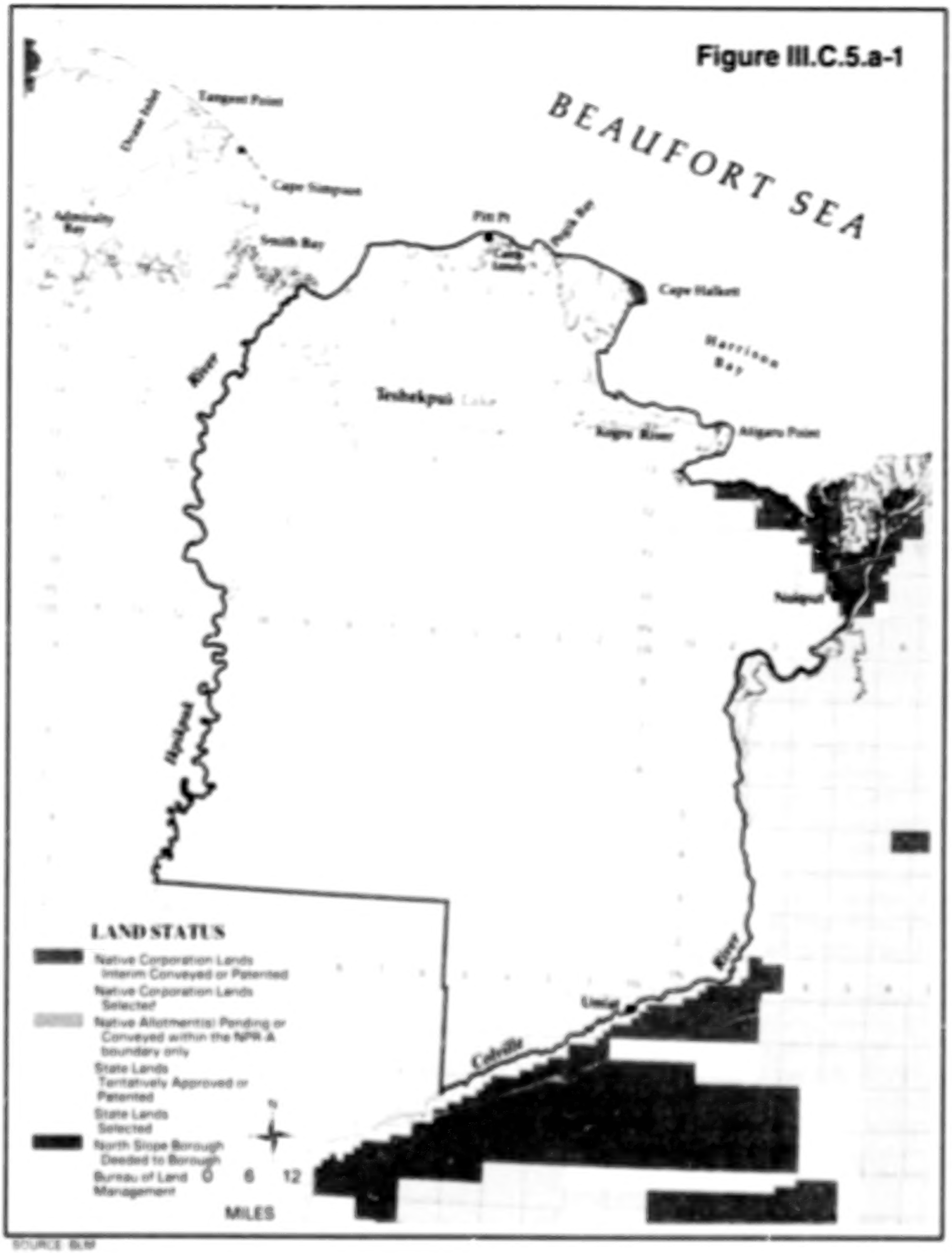
(c) **Unauthorized Use**: There are a number of structures, primarily cabins on Federal public lands without BLM authorization. An inventory to establish the location and ownership of these structures, as well as completion of survey and conveyance of Native allotments, must be completed before accurate numbers can be determined.

b. Coastal Zone Management: The Federal Coastal Zone Management Act (CZMA) (16 U.S.C. 1456), which was enacted in 1972 and last amended in 1990, and the Alaska Coastal Management Act (ACMA) (AS 46.40), which was enacted in 1977 and last amended in 1994, guide development and land use in coastal areas to provide a balance between the use of coastal areas and the protection of valuable coastal resources.

(1) **Alaska Coastal Management Program (ACMP)**: In 1979, the ACMP was approved pursuant to the CZMA. The ACMP includes enforceable policies and standards for development and natural resource use and conservation within the coastal zone. The coastal zone and coastal district boundaries are mapped in *Coastal Zone Boundaries of Alaska*, an atlas produced by the Alaska Division of Governmental Coordination (ADGC). All activities either occurring within the coastal zone or that may reasonably be expected to affect coastal resources and uses must be conducted in a manner consistent with the ACMP. While Federal lands are defined as being outside the coastal zone, Federal activities are to be reviewed for consistency with CMP's. In addition to State policies and standards, 33 coastal districts have developed CMP's with enforceable policies that, once approved, become part of and augment the ACMP. District programs must be approved by the Alaska Coastal Policy Council and by the Secretary of the U.S. Department of Commerce through the Office of Ocean and Coastal Resource Management (OCRM). The ADGC currently is in the process of publishing the ACMP enforceable policies. The Statewide standards that may be relevant to potential activities within the planning area hypothesized in this EIS are summarized below.

The NPR-A lies entirely within the boundaries of the NSB. The NSB's CMP is fully approved and is part of the ACMP. Under the CZMA, Federal lands are excluded from the coastal zone; however, uses and activities on Federal lands that directly affect the coastal zone and its resources must be consistent to the maximum extent practicable with enforceable standards of State CMP's. The exclusion of Federal lands does not remove Federal agencies from the obligation of complying with the consistency provisions of Section 307 of the CZMA, when Federal actions on these excluded lands have spillover impacts that affect any land or water use or natural resource of the coastal zone within the jurisdiction of a State's management program (15 CFR 923.33). A description of the NSB CMP follows that of the Statewide standards of the ACMP.

Figure III.C.5.a-1


BEAUFORT SEA
Tangent Point
Dease Inlet
Cape Simpson
Admiralty Bay
Smith Bay
Pitt Pt
Pogik Bay
Camp Lonely
Cape Halkett
Harrison Bay
Teshekpuk Lake
Kogru River
Atigaru Point
Nuiqsut
Ikpikpuk River
Colville River
Umiat
LAND STATUS
Native Corporation Lands Interim Conveyed or Patented
Native Corporation Lands Selected
Native Allotment(s) Pending or Conveyed within the NPR-A boundary only
State Lands Tentatively Approved or Patented
State Lands Selected
North Slope Borough Deeded to Borough
Bureau of Land Management
N
0
6
12
MILES

SOURCE: BLM

BEST COPY AVAILABLE

(a) Coastal Habitats: Eight coastal habitats were identified in the habitats standards (offshore; estuaries; wetlands and tidelands; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts, rivers, streams, and lakes; and important uplands). Each habitat has a policy specific to maintaining or enhancing the attributes that contribute to its capacity to support living resources (6 AAC 80.130[c]).

Activities and uses that do not conform to the standards may be permitted if there is a significant public need, no feasible prudent alternatives to meet that need, and all feasible and prudent mitigating measures are incorporated to maximize conformance. The habitat policy frequently is cited in State consistency reviews.

(b) Coastal Resources: Two policy areas come under the heading of coastal resources: (1) air, land, and water quality and (2) historic, prehistoric, and archaeological resources. In the first instance, the ACMP defers to the mandates and expertise of the State of Alaska, ADEC. The standards incorporate by reference all the statutes, regulations, and procedures of the ADEC that pertain to protecting air, land, and water quality (6 AAC 80.140). Concerns for air and water quality are cited frequently during State reviews for consistency.

The policy addressing historic, prehistoric, and archaeological resources requires only identification of the "areas of the coast which are important to the study, understanding, or illustration of national, State, or local history or prehistory" (6 AAC 80.150).

(c) Uses and Activities: Nine topics are addressed under this heading: coastal development, geophysical-hazard areas, recreation, energy-facility siting, transportation and utilities, fish and seafood processing, timber harvesting and processing, mining and mineral processing, and subsistence. Uses and activities of particular relevance to potential activities within the NPR-A include coastal development, recreation, energy-facility siting, transportation and utilities, and subsistence.

Both the Federal CZMA and the ACMP require that uses of State and Federal concern be addressed (CZMA Sec 303[2][C], AS 46.40.060, and AS 46.40.070). The ACMA further stipulates that local districts may not arbitrarily or unreasonably restrict or exclude such uses in their coastal management programs. Among the uses of State concern are the siting of major energy facilities and of transportation and utility routes and facilities.

(2) NSB Coastal Management Program: The NSB CMP was adopted by the Borough in 1984. Following several revisions, the NSB CMP was approved by the Alaska Coastal Policy Council in April 1985 and OCRM in May 1988. The coastal management boundary adopted for the NSB CMP varies slightly from the interim boundary of the ACMP. In the mid-Beaufort sector, the boundary was extended inland on several waterways to include anadromous-fish-spawning and -overwintering habitats. The Zoning Ordinance is enforceable within the Borough boundaries and to the 3-mi offshore limit of State waters. The NSB CMP is applicable inland to approximately 25 mi and beyond along the full length of all major river corridors.

The NSB CMP was developed to balance exploration, development, and extraction of nonliving natural resources and maintenance of and access to the living resources upon which the Inupiat traditional cultural values and way of life are based. Cultural and historic patterns of subsistence use of the natural resources in the NPR-A have been and continue to be of the highest priority to the NSB. The NSB's CMP and Land Management Regulations (LMR's) Zoning Ordinance have been implemented with the primary goal of protecting the subsistence lifestyle of the Borough's largely Inupiat population while encouraging and managing economic development. Major land uses on the North Slope are divided between traditional subsistence uses and hydrocarbon-development operations. The NSB CMP contains four categories of enforceable policies: (1) standards for development, (2) required features for applicable development, (3) best-efforts policies that include both allowable developments and required features, and (4) minimization-of-negative-impacts policies.

Standards for development prohibit severe harm to subsistence resources or activities or disturbance of cultural and historic sites. Required features address reasonable use of vehicles, vessels, and aircraft; engineering criteria for structures; drilling plans; oil-spill-control and -cleanup plans; pipelines; causeways; residential development associated with resource development; and air quality, water quality, and solid-waste disposal.

Best-efforts policies allow for exceptions if (1) there is "a significant public need for the proposed use and activity" and (2) developers have "rigorously explored and objectively evaluated all feasible and prudent alternatives" and briefly documented why the alternatives have been eliminated from consideration. If an exception to a best-efforts policy is granted, the developer must take "all feasible and prudent steps to avoid the adverse impacts the policy was intended to prevent."

Best-efforts policies allow development if all feasible and prudent steps are taken "to avoid the adverse impacts the policy was intended to prevent." Policies in this category address developments that significantly could decrease productivity of subsistence resources or ecosystems or restrict access of subsistence users to a resource. They also

Among the more attractive features of the planning area are those activities associated with the pristine quality of the region (e.g., backpacking, float trips, observing wildlife). These activities, coupled with the remoteness of the area, offer a more unique "wilderness" experiences compared to many other areas of the U.S. Even in Alaska, there are few areas such as the NPR-A where one can be 100 mi or more from the closest village or site of human activity. The principal outdoor recreational activities available in the planning area are described in the following sections.

(a) Backpacking and Hiking: Very little backpacking (overnight trip) or hiking (day trip) presently takes place within the planning area. It is likely that fewer than five recreational backpacking parties (4 persons per party) enter the area each year, and most of this use probably is limited to areas near Umiat. Backpacking and hiking also occur in the major river valleys in conjunction with float-boating activities. The backpacking/hiking season is rather short, generally from late June to early September. There are no developed hiking trails. Access for backpacking is by aircraft using the larger lakes and gravel bars as landing sites.

Opportunities for cross-country hiking or backpacking in the majority of the planning area are very poor. The vast areas of tussocks and/or wet, boggy terrain throughout all of the coastal plain are, for practical purposes, impassable in the summer. Most of the consistently good terrain for walking is in a narrow corridor of the Colville River riparian area. The scenery is more varied here than elsewhere in the planning area, and good camping sites are available. The bluffs of the Colville River provide excellent vantage points for viewing the landscape.

(b) Boating: Very little recreational use is made of the rivers in the planning area. Fewer than 15 multiday recreational float trips (4 persons per trip) are estimated to occur within the planning area each year. Most of the boating is done with rubber rafts or folding kayaks to facilitate access by aircraft, which land on gravel bars or beaches, large pools on the rivers, or on lakes.

Generally, the opportunities for float boating on rivers in the planning area are not outstanding in comparison to those opportunities offered elsewhere in Alaska. For example, none of the rivers in the area offer whitewater boating, because most of the rivers have an insufficient flow of water during much of this summer period. The snow melts rapidly in spring, and the thin vegetative mat overlying the permafrost provides little runoff once the snow is gone. Most of the runoff is discharged in a few days to, at best, several weeks. During the short-use season, however, certain rivers do offer outstanding float-trip opportunities. Some of the better boating rivers in the area are the Colville and the Ikpikpuk rivers. Being the larger of the two rivers, the Colville watershed is much larger than that of the other rivers, and the flow is correspondingly greater and more sustained. Floating the Colville may occur well into August.

The recreational value of rivers such as the Colville and the Ikpikpuk is their provision of a corridor for wilderness travel, including boating and hiking through the Arctic, because cross-country movement for long distances usually is not possible except in the winter. The riverine areas also provide some of the best places in the planning area for viewing wildlife.

Recreational boating and sailing on the many lakes and ponds in the planning area are not practical. Many of the lakes are very shallow and usually persistent winds, swampy shorelines, and difficulty of moving boats from one lake to another discourage boating on the lakes. The shallow depths of the lakes also limit access by plane.

(c) Sightseeing: According to Alaska's Outdoor Recreation Plan, sightseeing is one of the most popular recreation activities of Alaska's residents and the most popular recreation activity of visitors to Alaska (State of Alaska, Division of Parks, 1976:111-6,7). Although very little sightseeing occurs in the planning area, the opportunity to view wildlife in its natural habitat perhaps is the most exciting recreational opportunity in the region. Millions of waterfowl and other birds seasonally migrate to and through the area. The grizzly bear, arctic fox, wolf, wolverine, caribou, moose, various raptors, and other animals inhabit the area. Some species tend to gather in the river valleys at certain times of the year, while other animals are found in large numbers near the coast (USDOI, BLM NPR-A Task Force, 1978c). Following are descriptions of several wildlife-viewing areas within the planning area (USDOI, BLM, 1978d).

- The area along the northern coastal plain of the NPR-A, including Teshekpuk Lake, contains the highest concentration of geese, swans, dabbler and diving ducks, gulls, terns, jaegers, and loons in the NPR-A during the summer. In addition, snowy owls may be observed along the coastal area during the summer months.
- Areas along the Beaufort Sea are excellent opportunities to view marine mammals, specifically spotted seals, belukha and gray whales, and walruses during July and August. The snowy owl also is present. Large numbers of shorebirds and black brant are known to use the area for staging.
- The area located approximately north of 70° N. latitude, south of Teshekpuk Lake and between the Colville and Ikpikpuk rivers, has moderate to high concentrations of geese, swans, diving and dabbler ducks, jaegers, terns, and loons during the summer.

Along the Colville River from just south of Nuiqsut to the planning area boundary is a moderate concentration area for moose during the winter and caribou during the summer.

- The area on the middle and lower Colville River provides habitat for a subspecies of peregrine falcon (*Falco peregrinus tundrius*) and other raptors during the summer. North of Umiat, the chance for viewing ptarmigan along the river increases. The area also provides an opportunity for observing grizzly bears from June through September.
- The area located on the upper Ikpikpuk River affords opportunities to observe moose during the summer. Grizzly bears and ptarmigan also may be seen here from June through September.

The prime viewing conditions are related to the open, treeless nature of the arctic tundra, the tendency of some animals to concentrate in the riverine areas, the long hours of daylight during the summer, and lack of extensive contact with humans. Wildlife easily is seen at comfortable distances on the tundra; surprise encounters, which may startle the animals and cause them to move away, are less likely. If visitors are quiet and unhurried, they may watch and photograph the animals as they go about their daily routine of subsisting in the arctic environment.

Sightseers coming to the area are expected to not only be interested in observing numbers of wildlife but also in observing animal and plant relationships in an arctic environment. Caribou and bird migrations, tundra vegetation, and the profusion of animal and plant life during the summer will provide them with this opportunity

(d) Hunting: Big-game animals are the primary target of most sporthunting in the planning area. However, few trophy animals are found, and game populations are abundant only in scattered locations within the reserve. Harvest data compiled by the ADF&G generally represent both nonsubsistence and estimates of subsistence harvest.

Caribou of the Teshekpuk Lake Herd are the most numerous big-game animal in the planning area. Subsistence hunting by North Slope residents accounts for most of the caribou harvest within this herd.

Most moose are taken within the Colville River drainage, particularly near Umiat. A recent breakdown of hunter types is not available; however, according to the ADF&G (1976a), approximately 30 percent of the hunters are not Alaskan residents, 20 percent reside within the Arctic Slope, and the rest are Alaskans from other areas of the State. Moose populations on the North Slope and especially on the Colville River recently have declined significantly, and moose hunting in the area is severely curtailed by the ADF&G. What moose are available along the Colville tend to concentrate along the middle Colville in the winter; therefore, they are vulnerable to harvest, because access by aircraft or boat from Umiat or Nuiqsut is excellent until snow and ice cover the gravel bars and the river (USDOI, BLM, 1978d). When moose populations come back to ADF&G-approved levels, both guided trips and subsistence hunting are expected to increase.

Grizzly bears are the only bears hunted in the planning area, because black bears are not known to inhabit the area. Grizzlies are taken during the fall and spring. Bears are hunted in the foothills and protected river valleys of the southern portion of the planning area. The highest population of bears in the NPR-A is found in the southwestern portion of the NPR-A (USDOI, BLM, 1978d). Few other animals are harvested by "recreational hunters."

(e) Sportfishing: Sportfishing on the Arctic Slope primarily is done incidental to other activities, such as big-game hunting, construction or government projects, and float boating. Most fishing occurs during the ice-free summer months (ADF&G, 1976b), although the fishing season is open all year. Areas where fish are likely to be caught are in the deeper (>6 ft) coastal lakes and the middle and lower Colville River.

The overall, long-term potential for the sport harvest of fish is low when compared with opportunities in many other areas of Alaska. Fish in the planning area are vulnerable to overfishing. However, due to the lack of present fishing pressure in these remote waters, good fishing can be experienced in some localities, and limited trophy fishing may be available. Fishes are most abundant in lakes having inlets or outlets, depths >6 ft, and suitable spawning substrate (USDOI, BLM, 1978d).

In some places, opportunities for sportfishing in streams deteriorate as summer progresses and low-water conditions occur. The locations in the planning area likely to experience these conditions are the tundra streams on the coastal plain and tributaries of the Colville River (NPR-A Work Group 3, 1977, unpublished data).

(f) Winter Activities: Very little winter recreation is known to occur in the planning area beyond the immediate area of the villages. Native and some non-Native residents travel extensively by snowmachine. Most of this travel is linked to subsistence hunting and fishing and to visiting other villages, but some of it is for recreation. The gentle terrain and wind-packed snow throughout much of the planning area creates favorable snow conditions for snowmachining, dogsledding, and possibly cross-country skiing. The best skiing was found in the river and creek drainages, where snow is deeper and the hard-pack surface more level. The wind in the Arctic can be a serious deterrent to any recreational activity, particularly when it blows loose snow that restricts visibility and creates severe wind-chill hazards. The possibility of getting lost within the vast relative flatness of the area's coastal plain is another obstacle to winter recreational use by both visitors and local residents. Because of these conditions, the potential for winter recreational use probably is limited to the vicinity of the villages, major river drainages, parts of the mountains, the Beaufort Sea coastline, and well-established winter trails. The most favorable months for winter recreating activities are April and May, when temperatures are usually higher and periods of daylight longer.

(g) Tourism: Tourism probably will account for the most significant increase in the total number of visitors to the region in the future. However, few of these visitors leave the immediate vicinity of the village (i.e., Native Corporation lands) and do not use public lands.

(h) National Wild Rivers (Wild and Scenic Rivers): A review of the previous planning efforts and Wild and Scenic Rivers (WSR) inventories and studies revealed that the planning area has been reviewed for WSR values at least two times previously.

The first study was completed in July 1972 by the Bureau of Outdoor Recreation. In a report titled *Alaska Task Force Report on Potential Wild and Scenic Rivers as part of the Native Claims Settlement Act*, two rivers within the study area, the Colville and Ikpikpuk rivers, were identified for further review.

The second WSR inventory was conducted as a result of a provision contained within Section 105(c) of the NPRPA. In compliance with this Act, the Colville and Ikpikpuk rivers again were inventoried and studied for WSR designation. No rivers in the planning area currently are included in the National WSR System.

1) Colville River: The Section 105(c) report (December 1978) states:

> The Colville river from its headwaters to Umiat meets the criteria established by the WSRA for inclusion into the National WSR system as a 'wild river area.' Outstanding values associated with the river area are: wildlife, geologic, recreational and possible archeological.

Under provisions of the Wild and Scenic Rivers Act, as amended in 1984, Congress had a timeframe of 3 years after submission of the study report to address designation of the Colville as a wild and scenic river. Congress did not take any action on designation, and the river corridors returned to their former status. The ANILCA directed the Secretary to study several rivers in Alaska; but in the case of the Colville River, it said that the 105(c) study is sufficient for Congressional purposes. The effect of this directive was that the Colville was placed in a protective management states. Protective management limits projects that would adversely affect the free-flowing nature of the rivers and provides as a measure of protection and for the enhancement of the "outstandingly remarkable values" that made the river eligible for WSR status. Interim protection of the WSR values was afforded the Colville River until September 1984.

Updated Eligibility Finding, Headwaters to Umiat (Fig. III.C.6-1, river reach #1 and 2, 321 mi): Field reconnaissance revealed that there has been little change in the status of the Colville River between its headwaters and Umiat. There has been no change in the land use or user patterns on the river, and no additional economic, industrial, road, or transportation-corridor development affecting its tentative classification as "wild." The only development on these river reaches (331 river miles) are small subsistence camps and the airport at Umiat.

The 1978 report accurately characterized the Colville River as a "wilderness river." Subsistence use has remained important. Identified river values include recreation, wildlife viewing (grizzly bears, caribou, and peregrine falcons), geologic, and archeological.

Updated Eligibility Finding, Umiat to Nuiqsut (Fig. III.C.6-1, river reach #3 and 4, 97 mi): The Colville River drainage provides optimum habitat for gyrfalcons, rough-legged hawks, ravens, and *Falco peregrinus tundrius*, a subspecies of peregrine falcon. The Colville River between Umiat and Ocean Point contain the core breeding grounds of the peregrine falcon. It is estimated that 100 to 150 breeding pairs are found along the Colville (Swem, 1997). This river reach contains the most concentrated population of arctic peregrine falcons on the Arctic Slope. From Awuna to Umiat, the populations are not as concentrated, but outstanding opportunities to view these raptors are provided. In 1977, the Colville River was designated as a "special area" by the Secretary of the Interior to protect nesting habitat for peregrine falcons and other raptors.

On the low bluffs near Ocean Point, exposed by the Colville River's cutting of the Chandler Formation, North America's northernmost dinosaur remains have been discovered. While the site was first recorded in a USGS report in 1923, it was not until 1986 that field investigations revealed the importance of this Late Cretaceous site. Within a 4-m stretch, more than 4,000 skeletal elements, including teeth, ossified tendons, and bones, have been mapped. Gangloff (1992) classifies the Ocean Point site "as the most productive Late Cretaceous

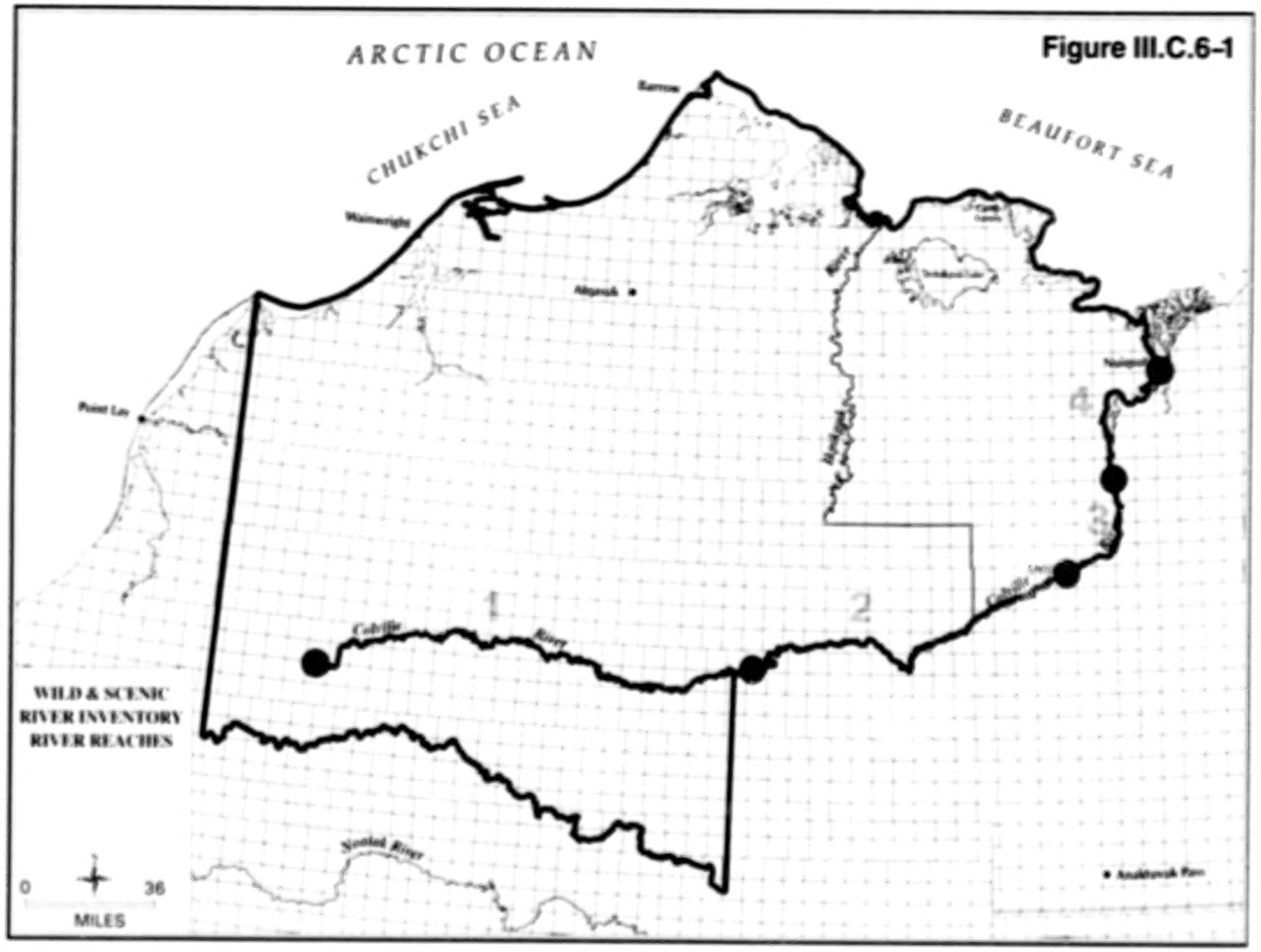


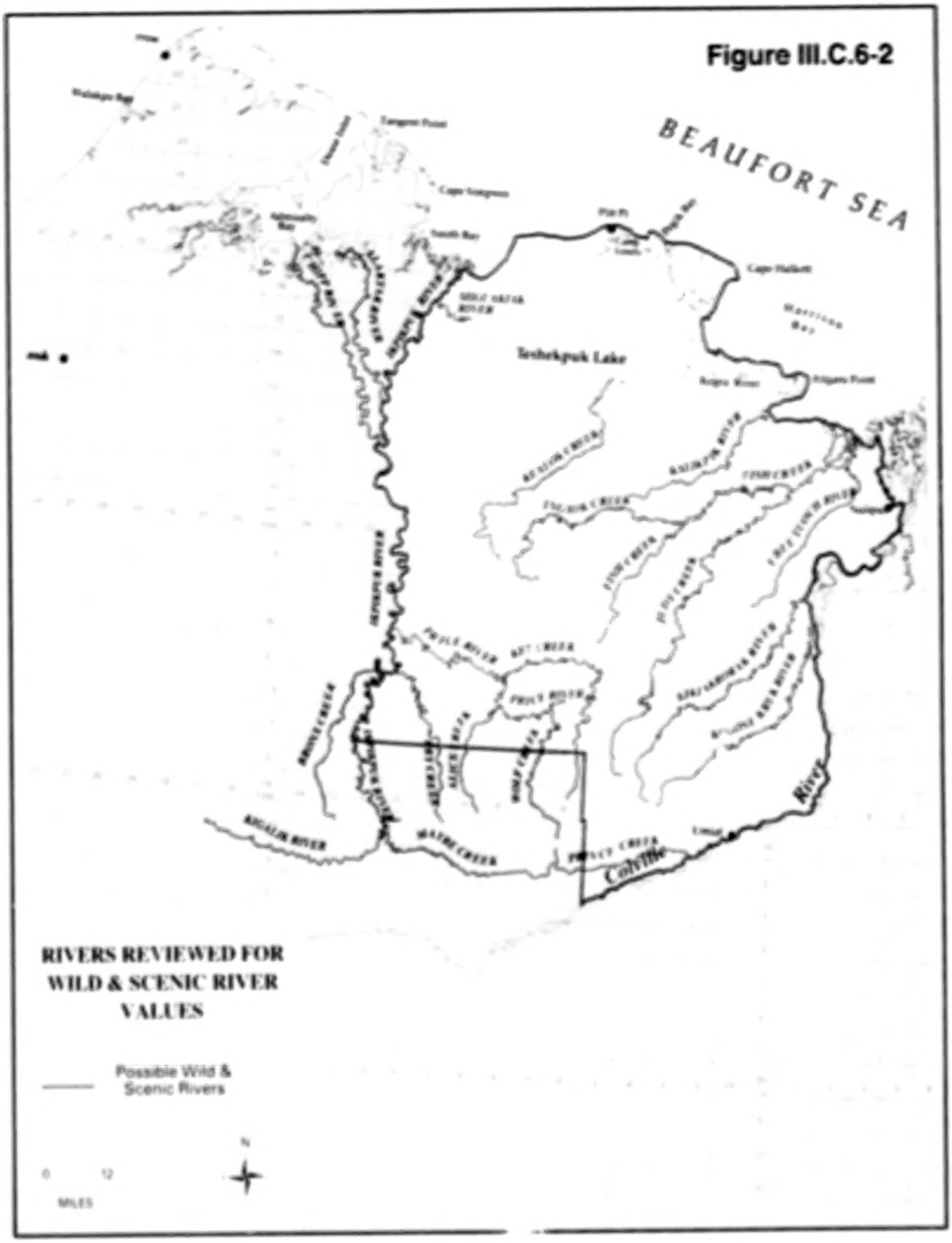
Figure III.C.6-1

WILD & SCENIC RIVER INVENTORY RIVER REACHES

BEST COPY AVAILABLE

BLANK PAGE

Figure III.C.6-2



RIVERS REVIEWED FOR WILD & SCENIC RIVER VALUES

BEST COPY AVAILABLE

245

is not vigorously promoted. Emergency landings are possible at various DEW-Line sites located along the coast.

(3) Recreation Experience Opportunities: Within the planning area, the opportunity provided for recreational experience is best described as primitive; i.e., the opportunity for isolation from other sights and sounds of humans and to feel a part of the natural environment is high; the area is characterized by an essentially unmodified natural environment with a very low concentration of users and minimal evidence of other users; and the activity opportunities are not dependent on BLM-facility development. However, because current management use of snowmachines and motorized boats is allowed and because the NPR-A is set aside for oil and gas development, the activity/setting opportunity provided within the planning area may best be described as semiprimitive motorized.

(4) Wilderness: Wilderness values were evaluated during the Section 105(c) studies. Practically all of the NPR-A today remains in a primitive state and is essentially de facto wilderness. The resident population of the planning area travels extensively by motorized vehicles (primarily snowmachines) over parts of the planning area and occupies seasonal dwellings or fish camps outside of the villages, which are permitted uses in Alaskan-designated wilderness areas. There are no roads outside of the villages. The reserve has been subject to oil and gas exploration intermittently since the 1920's. However, the overall impression of the planning area over 4 million acres is that it is a natural area, untrammeled by humans, with very few obvious sights of modern humanity's influence or presence. A visitor to the area or an inhabitant of one of the few settlements in or near the NPR-A can easily find opportunities for solitude (USDOI, BLM, 1978d).

However, Section 1001 of the ANILCA provides further guidance for this planning document:

> The Secretary shall initiate and carry out a study of all Federal lands (other than submerged lands on the Outer Continental Shelf) in Alaska north of 68 degrees north latitude and east of the western boundary of the National Petroleum Reserve-Alaska, other than lands included in the National Petroleum Reserve-Alaska and in conservation system units established by this Act.

This study included wilderness evaluation and recommendation, but in particular, it excludes NPR-A lands. In addition, BLM is under Secretarial direction to not do further wilderness reviews and/or studies within the State of Alaska except in those areas where study is mandated by legislation.

Table III.C.6-1
Wild and Scenic River Eligibility Summary

Stream Name	Miles	Free Flow?	Outstandingly Remarkable Values?	Eligible?[1]
Alaktak River	55	Yes	None identified	No
Alice Creek	39	Yes	None identified	No
Fish Creek	128	Yes	None identified	No
Fry Creek	68	Yes	None identified	No
Inigok Creek	210	Yes	None identified	No
Judy Creek	138	Yes	None identified	No
Kalikpik River	54	Yes	None identified	No
Kealok Creek	77	Yes	None identified	No
Key Creek	91	Yes	None identified	No
Kikiakorak River	101	Yes	None identified	No
Kogosukruk River	90	Yes	None identified	No
Miguakiak River	12	Yes	None identified	No
Prince Creek	46	Yes	None identified	No
Tingmeachsiorik Riv.	28	Yes	None identified	No
Ublutuock River	56	Yes	None identified	No
Wolf Creek	57	Yes	None identified	No
Ikpikpuk River	140	Yes	None identified	No
Colville River				
headwaters to ASRC boundary	321	Yes	Recreation, Wildlife viewing, Geology, Archeology	Yes
Umiat to Nuiqsut	97	Yes	Paleontology, Wildlife	Yes

[1] Eligibility of area streams for inclusion in the National Wild and Scenic Rivers system

b. Visual: An in-depth inventory of visual resources within the planning area was conducted as part of the NPR-A 105(c) studies completed in 1979. The section entitled Scenic Quality Evaluation contained in that study remains the best available information on the subject.

The scenic-quality evaluation describes the characteristic landscape and determines scenic-quality ratings for the visual resources of the NPR-A. Visual resources are defined as the land, water, vegetation, animals, and structures that are visible on the land. The evaluation is intended to represent the overall impression a viewer has of the visual resources rather than the view from any one location, including an aerial view, or during any one season of the year.

The NPR-A was divided into 16 scenic-quality-rating units (SQRU's) using the basic elements of landform, vegetation, water, color, distinctiveness, and cultural modification. Landform, vegetation, water, and color are selfexplanatory. Distinctiveness is used to measure a scenic resource that is very rare or unique within a region or may be somewhat more common but, because of its distinguishing characteristics, is unusually memorable. Cultural modifications are defined as any human-caused change in the land- or waterform or vegetation or the addition of a structure that creates a visual contrast in the basic elements (form, line, color, texture) of the natural landscape.

Each SQRU was evaluated to determine its scenic quality. The planning area has four SQRU units—the Beaufort Sea coast, Wet Plains, Ridges, and the Colville River. Each SQRU was rated on a scale of A through C as to the quality of its visual aesthetics.

Class A SQRU has a great deal of visual variety, contrast, and harmony.
Class B SQRU has a moderate amount of visual variety, contrast, and harmony.
Class C SQRU has little visual variety, contrast, and harmony.

The following is a brief description of each SQRU using the key elements of landform, vegetation, water, color distinctiveness, and the overall effect that cultural modification has had on the scenic quality of the SQRU.

The Beaufort Sea Coast SQRU, Class Rating C: The Beaufort Sea Coast SQRU consists of a 1-mi (1.6-km) wide band along the Beaufort Sea coastline.

Wet Plains—Large Water Bodies, Class Rating C, and Remaining Wet Plains, Class Rating C: The presence of many thousand lakes distinguishes the wet plains from other rating units. Teshekpuk Lake is an example of a large waterbody scenic-quality rating. The ice-wedge polygon patterns and numerous elliptical and elongated lakes that dot the landscape and make up a portion of the central to southern part of the planning area are examples of oriented lakes scenic-quality ratings.

Ridges, Class Rating C: The Ridges SQRU is predominantly in the southern region of the planning area extending west from the Colville River. The ridges unit is distinguished by low east-west ridges, which are 4 to 6 mi wide. The ridges have been cut by meandering streams leaving a series of buttes, mesas, and some steep-walled faces next to the Colville River.

Colville River Valley—Middle Colville, Class Rating A; Lower Colville, Class rating B: The Middle Colville SQRU consists of the riparian area of the river from the southeastern tip of the planning area to Umiat along the Colville River. The Lower Colville SQRU consists of the riparian area of the Colville from Umiat downstream to the mouth.

7. Transportation: The following section focuses on those facets of Alaska's transportation system that would be directly affected by the IAP. The planning area lies adjacent to Prudhoe Bay and the Kuparuk oil reservoir. Prudhoe Bay/Kuparuk reservoir are mature producers supported by an extensive network of access roads and crude-oil-gathering lines. This network is constantly expanding as new and satellite crude-oil-production sites are identified. A new production site, the Alpine project, has brought the expanding North Slope infrastructure to the edge of the NPR-A. Pertinent land routes (Dalton Highway, North Slope oil roads, associated trails, and rights-of-way), airports and airstrips, and cargo-docking facilities are discussed in this section.

Within the NPR-A, roads (even identified rights-of-way) and airstrips are minimal, and no marine facilities exist along the Reserve's coast. Any future expansion into NPR-A by the oil and gas industry would be accomplished from existing North Slope infrastructure. For these reasons, this section concentrates on the existing Prudhoe Bay/Kuparuk facilities east of the NPR-A as well as those facilities within the NPR-A.

a. Road Systems: The Dalton Highway (also known as the Haul Road) is a north-south, 415-mi long, all-weather gravel road that connects Livengood with the Deadhorse airstrip at Prudhoe Bay. Located north of Fairbanks, the community of Livengood is connected to Fairbanks by a 75-mi section of the Elliot Highway. The Dalton Highway is the sole overland route connecting Prudhoe Bay to Alaska's other major highway systems. The Dalton Highway is 28 ft wide with an average of 3 to 6 ft of gravel surfacing. Historically, only the portion of the highway from Livengood to the Yukon River Bridge, and later Disaster Creek, was open to the public. In 1995, the highway was opened to public access as far as the security gate at Deadhorse. Beyond the security gate, the oil roads are privately owned and maintained.

The majority of the vehicles traveling the Dalton Highway are commercial freight vehicles associated with oilfield activities, although privately owned vehicles and commercial-tour operators also travel the Dalton Highway. Not unexpectedly, summer-traffic levels for the Dalton (June-August) are substantially higher than traffic levels for the rest of the year. During summer months, the monthly average daily traffic count at milepost 134, Yukon River Bridge, varied between 385 and 400 vehicles; however, the annual average daily traffic (AADT) count at the same checkpoint for the year combined was 150 to 200. Farther north on the Dalton Highway, AADT levels fall rapidly. At the Atigun River checkpoint, AADT levels are

100 to 125 (State of Alaska, Dept. of Transportation Public Facilities, 1996).

Annual truck traffic (combined loaded and unloaded) in 1996 was 45,236 trucks, with a monthly average of 3,770 traveling the Dalton Highway. Truck volumes have increased substantially between FY's 1990 and 1996, with much of the increase occurring in the last 3 years. Until 1995, monthly truck-traffic averages fell below 2,800 trucks.

The main road within the Prudhoe Bay Kuparuk operations area is the Spine Road. This road crosses through both the Western and Eastern Operating Areas, providing access from Deadhorse west to the Kuparuk Base Camp and east to the Endicott oilfield. Milne Point, the Oliktok field, and other satellite fields and facilities within the operating area are connected to the Spine Road; however, the newly discovered Alpine field, located in the Colville River delta will be connected by an ice road to the Spine Road as opposed to the North Slope norm of a gravel road. Exploratory drilling of the Alpine prospect also was assisted by ice-road connections to the Prudhoe Kuparuk complex with no gravel roads emplaced. The gravel roads typically are 35 ft wide and elevated approximately 5 ft above the ground.

Within Prudhoe Bay's Eastern and Western Operating Area, there are approximately 161 mi of interconnected gravel roads. There are approximately 6 mi of other interconnected roads within the Kuparuk River Unit. There also are 8 mi of causeways providing access to facilities and drilling sites, including the 5-mi long causeway that provides access to the Satellite Production and Main Production Islands at the Endicott field. Traffic data are not available on the roads within the Prudhoe Bay Kuparuk operating area (Fig. III.C.7-1).

Nuiqsut and other North Slope villages have gravel roads that provide access to the airstrip, housing, and community facilities. During the winter months, the roads are covered with ice and transportation is by cars, trucks, snowmachines, and other all-terrain vehicles (ATV's). During the summer months, the roads are used by cars, trucks, and ATV's. Data are not available for traffic volume on Nuiqsut's road system.

b. Aviation Systems: There are three major airstrips in the Prudhoe Bay Kuparuk area—the State-owned and operated Deadhorse airport and the privately owned and operated Prudhoe Bay and Kuparuk airstrips. The Deadhorse airport is served by a variety of aircraft and can accommodate Boeing 737 jet aircraft. The Deadhorse facility has an asphalt airstrip approximately 6,500 ft long by 150 ft wide. The airport has a small passenger terminal as well as hangars, storage warehouses, and equipment for freight handling. Annual passenger counts for scheduled flights (Alaska Airlines) into Deadhorse are estimated at 140,000 persons. Total annual passenger counts for Aviation Shared Services for both arriving and departing personnel ranged between 205,000 and 220,000 during the period 1992 to 1996 (Ahern, 1997, pers. comm.). Aviation Shared Services transports only employees, contractors and cargoes of BP Exploration and ARCO. It is staffed and operated by ARCO personnel; however, its operational costs are jointly underwritten by BP Exploration and ARCO. Commercial cargo service also is provided into Deadhorse as well as satellite oilfield strips. Annual tonnage shipped by air into the Prudhoe Kuparuk complex is difficult to estimate. A range of 250 to 500 tons is probable, as most cargo tonnage is brought up over the Dalton Highway.

Both the Prudhoe Bay and Kuparuk airstrips are owned and operated by Aviation Shared Services. These airstrips are served by leased commercial aircraft to transport industry personnel (ARCO and BP Exploration employees and contractors). The two airstrips at Prudhoe Bay and Kuparuk are approximately 6,500 ft long and 150 ft wide. They primarily are used by Aviation Shared Services providing scheduled flights several times per week to this location (Morrison, 1997, pers. comm.).

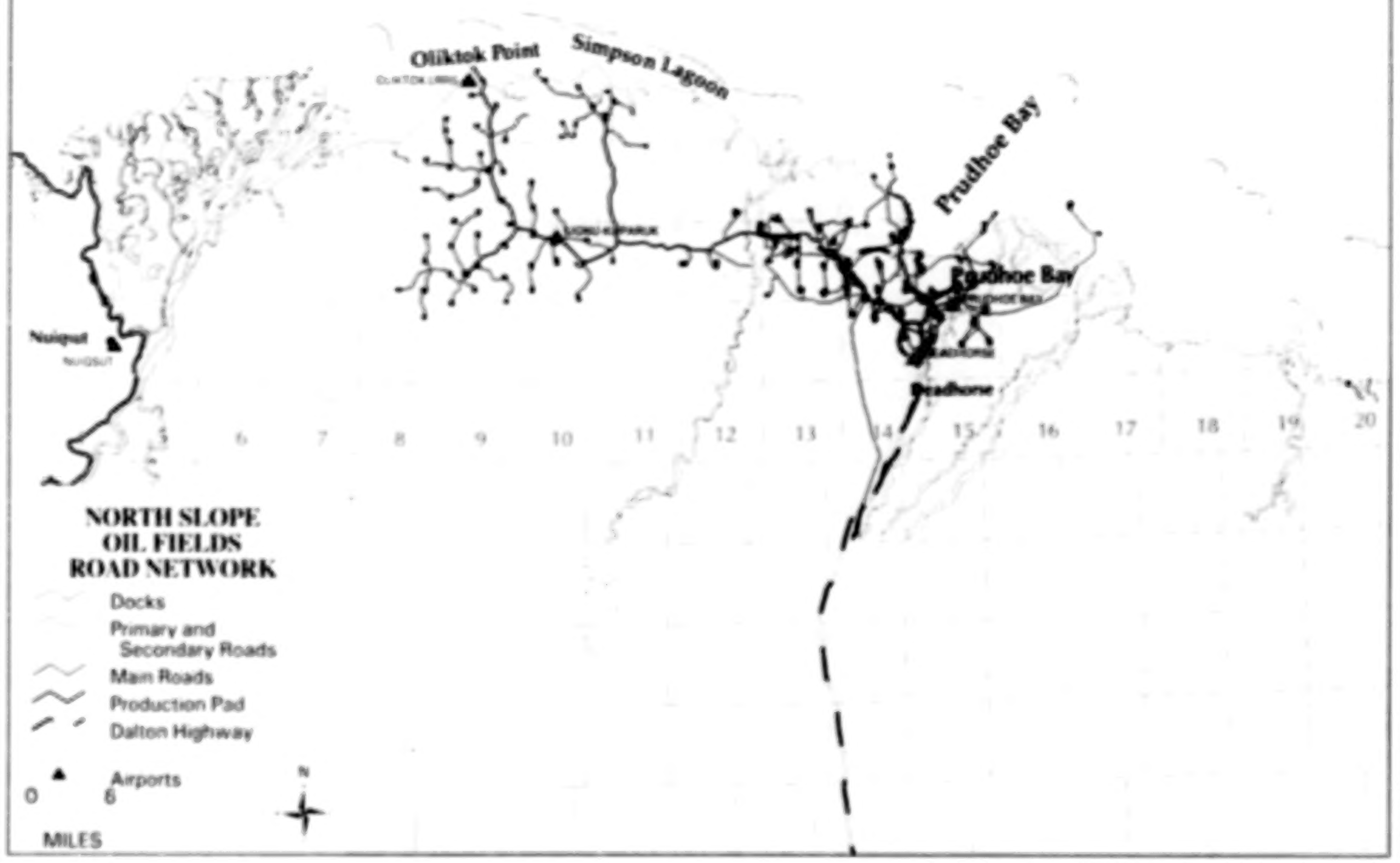
Barrow has a State-owned airport with an asphalt runway approximately 6,500 ft long and 150 ft wide. Barrow is the transportation hub for villages on the North Slope. Alaska Airlines provides regularly scheduled jet passenger flights into Barrow from Anchorage and Fairbanks, with other air companies offering shuttle service to various North Slope communities. The Barrow airstrip is accessible year-round with use constraints involving severe weather, an occasionally obstructed runway, and migratory waterfowl that may be present in the area during spring and fall. Available airport services include minor airframe and power plant repairs (USDOC, NOAA, 1997). Airport facilities include two large hangars, storage warehouses, and equipment for freight handling.

Nuiqsut is serviced by a 4,500-ft long gravel airstrip located adjacent to the village. The airport is equipped with a rotating beacon, approach lights, high-intensity runway lights, and visual-approach slope-indicator systems. The runway is unmanned and not monitored (USDOC, NOAA, 1997). The community is served by twice-daily flights that bring in passengers, cargo, and mail service. These commercial flights connect it with Barrow and Deadhorse. In addition, chartered aircraft use the airport on a regular basis.

c. Marine Transportation Systems: Marine transportation on the North Slope generally is freight oriented with the exception of relatively small, inboard-

BLANK PAGE

Figure III.C.7-1



SOURCE: BP Exploration (Alaska) Inc. Current as of 4/1/97

BEST COPY AVAILABLE

249

and outboard-engine watercraft used privately by villagers and less frequently for scientific research. Marine transportation provides an economical means of transporting heavy machinery and other cargo with a low value-to-weight ratio. Marine shipments to the North Slope are limited to a seasonal window between late July and early September, when the arctic coast is ice free. Port facilities on the North Slope range from shallow-draft docks with causeway-road connections to facilities located at Prudhoe Bay to beach-landing areas in North Slope communities. Cargo ships and oceangoing barges are typically offloaded to shallow-draft or medium-draft ships for lightering to shore due to a lack of deepwater ports. Occasionally, smaller craft also are used to transport cargo upriver to areas not located on the coast.

There are three dockheads for unloading barges located at Prudhoe Bay—one at East Dock and two at West Dock. A 1,100-ft long causeway connects East Dock to a 100- by 270-ft long wharf constructed from grounded barges (USDOD, US Army COE, and ERT, 1984). This dock is no longer in use. West Dock, a 13,100-ft long by 40-ft wide, solid-fill, gravel causeway, is located along the northwestern shore of Prudhoe Bay east of Point McIntyre. There are two unloading facilities off of the gravel causeway at West Dock. One facility is located 4,500 ft from shore and has a draft of 4 to 6 ft. The second facility is located about 8,000 ft from shore and has a draft of 8 to 10 ft. Water depths around the causeway average 8 to 10 ft (USDOD, US Army COE, and ERT, 1984).

Another dock exists at Oliktok Point; it extends 750 ft from the original shoreline. At the dockface, the water depths reach 10 ft while at the bottom of the dock's boat ramp, water depths draw at least 5 ft. The Oliktok facility also doubles as a seawater-treatment plant (Rookus, 1997, pers. comm.).

Marine sealifts bring oilfield supplies and equipment to the Prudhoe Bay Deadhorse area as the expansion or construction of additional facilities are required. Arrival and offloading is affected by the presence of sea ice. The ice-free window occurs generally from late July through early September.

There are no port facilities in Barrow. Supplies and cargo are brought into the area by barges and larger cargo ships and taken to shore by smaller vessels. Supplies are either offloaded directly onto the beach or are lifted off by crane. The primary area used for offloading supplies is located north of the community. Nuiqsut is located roughly 18 mi upriver from the sea on a channel of the Colville River. Supplies and cargo are brought to the shoreline of the Beaufort Sea by barges and larger cargo ships and then taken upriver by smaller vessels.

d. Pipeline Systems: All North Slope production and all potential NPR-A production will be transported to the TAPS Pump Station No.1 for transport to Valdez for shipment. There are seven major trunk pipeline systems that carry crude oil to the TAPS—Prudhoe Bay East, Prudhoe Bay West, Oliktok, Endicott, Lisburn, and Kuparuk. These systems total approximately 141 mi in length and are in various stages of current and expected throughput. These pipelines are all aboveground, elevated on vertical support members. Access roads run along each of the pipelines to provide for operations, maintenance, and repair (Fig. III.C.7-2).

Crude oil produced from the planning area will be transported to Pump Station No. 1 through the 22-mi long Kuparuk Pipeline. Oil flow in the Kuparuk line is expected soon to reach 335,000 bbl per day. Additional production at the newly discovered Alpine prospect as well as additional discoveries in the NPR-A may create a product flow in excess of the Kuparuk line's carrying capacity. Serving these major TAPS gathering lines are numerous production-pad feeder lines.

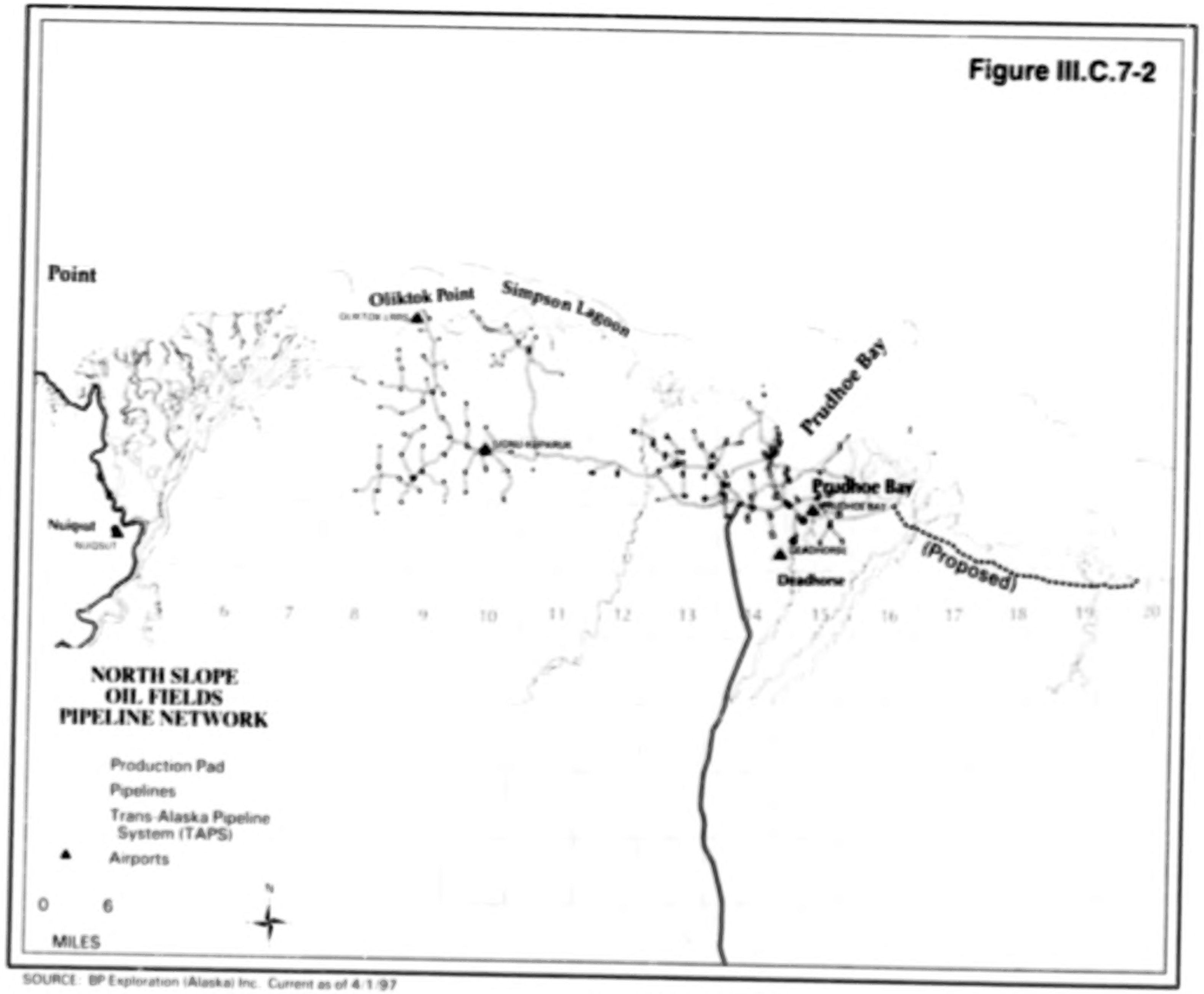
From Pump Station No. 1, the TAPS heads south for over 800 mi to an oil-transhipment terminal located at Valdez on Prince William Sound. The oil pipeline has a diameter of 48 in with a 30-ft wide access road running adjacent to it. Approximately 376 mi of the pipeline is buried to a depth between 3 and 12 ft, the other 420 mi of the pipeline is built aboveground mounted on vertical support members.

Currently, the TAPS can throughput up to 2.2 MMbbl per day; however, by the end of 1997 its maximum throughput will fall to 1.75 Mmbbl per day with the closure of two more pump stations. These closures will reduce the number of pump stations to 6, down from a one-time high of 10. Currently, the actual daily throughput of the TAPS averages 1.3 to 1.4 MMbbl. The TAPS southern terminus is the Valdez Marine Terminal. The terminal has 18 crude-oil-storage tanks with a total capacity of 9.18 Mmbbl. In 1996, there were 619 loaded oil-tanker departures from the Valdez terminal (Bogart, 1997, pers. comm.).

e. NPR-A Facilities: Transportation facilities within the NPR-A are few. Apart from Nuiqsut, the only facilities that warrant special attention are those at Lonely, Umiat, and Inigok. Lonely is the site of a remotely controlled DEW-Line station that also doubled as an oilfield-support base for Husky Oil during the 1974 to 1982 NPR-A exploration period (Fig. III.C.7-3). At that time, the Lonely camp contained a well-maintained gravel runway 5,200 ft long by 150 ft wide, runway lighting, and beacons as well as navigational aids, fuel supplies, and warehousing. At the end of the Husky Oil exploration period, the Husky logistics facility at Lonely was surplused out for public bid and was purchased by CIRI. Currently,

BLANK PAGE

Figure III.C.7-2



SOURCE: BP Exploration (Alaska) Inc. Current as of 4/1/97

BEST COPY AVAILABLE

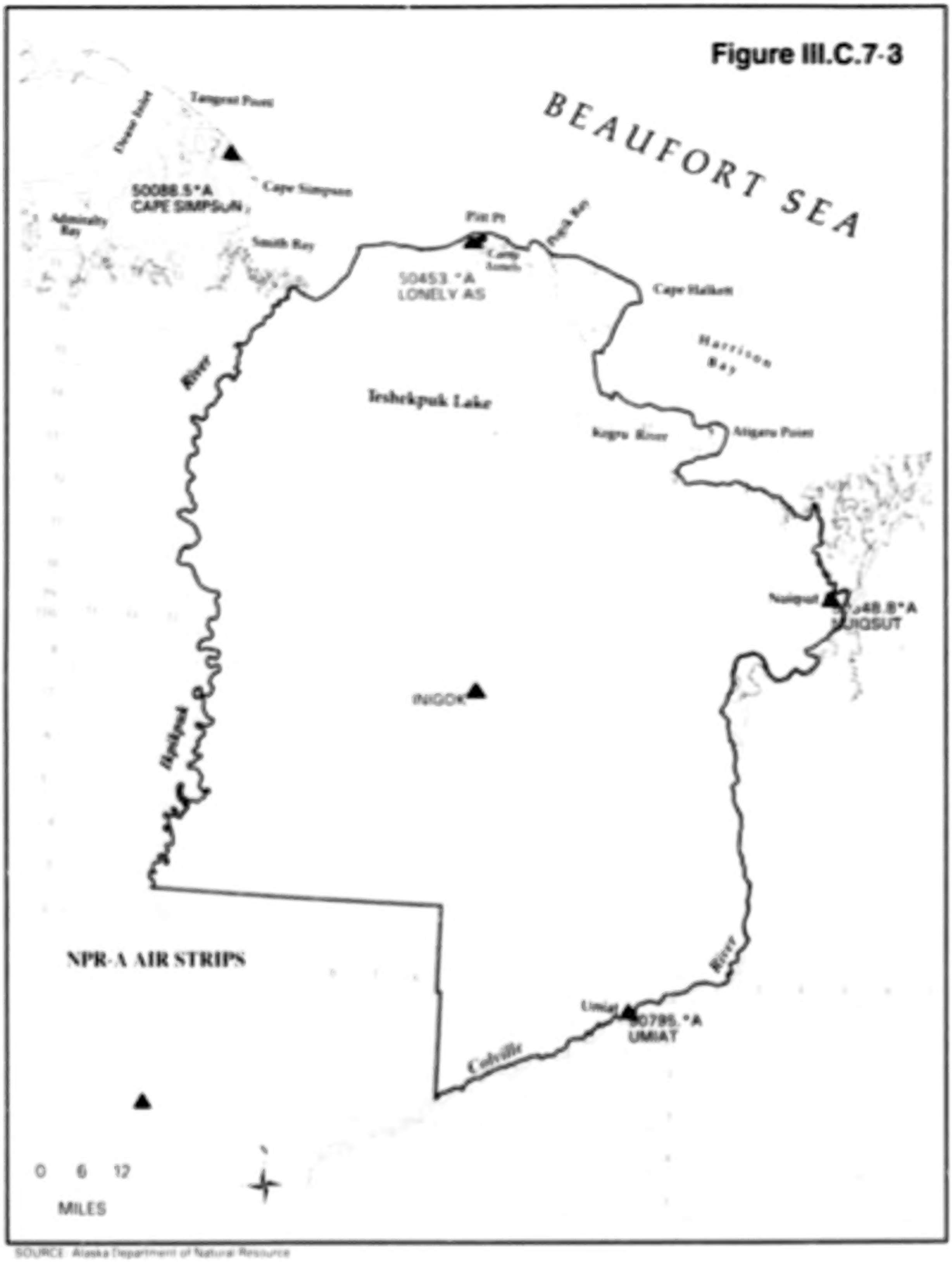


Figure III.C.7-3

SOURCE: Alaska Department of Natural Resource

BEST COPY AVAILABLE

252

Lonely's airport is closed and its condition is unknown. The Lonely DEW-Line station does have a short pipeline for offshore oil deliveries from tanker barges and a gravel barge-landing site (Meares, 1997, pers. comm.).

The Umiat facility is a public airstrip operated by the State of Alaska. During summer months, the airstrip is maintained by Umiat Enterprises, a private contractor; however, there is no winter maintenance. The field is 5,400 ft by 74 ft, has some navigational aids and runway lights, and can accommodate Hercules-class cargo aircraft (Meares, 1997, pers. comm.). Privately owned facilities are located next to the airstrip.

Inigok, the third major airstrip, is located at a former Husky Oil drilling site. The airstrip, estimated at 7,000 ft by 100 ft, was constructed during 1977 and experienced its first loaded cargo aircraft (C-130) landing in June 1978. The Inigo facility is an insulated gravel airstrip. Approximately 1 ft below the gravel surface, the runway is underlain by polystyrene foamboard. Below the foamboard to a depth of 6 ft from the runway top is a layer of permanently frozen sand fill (Kachadoorian and Crory, 1988). Due the nature of its construction, the Inigok strip remains useable some 18 years after its abandonment and is routinely used by the BLM during the summer (Meares, 1997, pers. comm.).

f. Ice Roads: Historically, the Inupiat navigate from Barrow to the Nuiqsut region along a cluster of coastal and landfast ice routes. Weather and ice conditions often dictate the route used. Along these routes, they travel to Teshekpuk Lake, the Colville River dlta, and Nuiqsut. Since 1983, ice bridges have been constructed across the Colville River. The first bridge was built to facilitate drilling on a lease held by the ASRC. The second bridge, built by the people of Nuiqsut in 1984, helped the village respond to a fuel crises. (Smith, Copeland, and Grundy, 1985, as cited in Tremont, 1987). Since then, villagers have traveled through the Prudhoe/Kuparuk Industrial complex to gain access to the Dalton Highway (Finkler, 1997, pers. comm.).

SECTION IV

ENVIRONMENTAL CONSEQUENCES

IV. ENVIRONMENTAL CONSEQUENCES

A. INTRODUCTION AND BASIC ASSUMPTIONS FOR EFFECTS ASSESSMENT:

The potential effects of the proposed Northeast NPR-A Planning Area Integrated Activity Plan (IAP) are assessed in Section IV of this IAP/EIS; the order in which the topics of this section are presented is as follows. This assessment includes the potential effects that each of five alternatives (A, B, C, D, and E) might have on the resources in and adjacent to the planning area. The potential impacts of other past, present, and reasonably foreseeable future activities are analyzed in the cumulative case. In addition, Section IV also includes discussions of environmental effects that cannot be avoided should the plan be implemented, the relationship between short-term uses of humanity's environment and the maintenance of long-term productivity, and any irreversible or irretrievable commitments of resources that would be involved in the plan, if it is implemented.

The IAP includes a range of oil and gas leasing options and the potential effects of this action, which focus primarily on oil development. These potential effects are analyzed in Alternatives B, C, D, and E and Sections IV.C, D, E, and F, and natural gas development and production is analyzed in Section IV.K. Alternative A is the No Action Alternative and does not include an oil and gas leasing proposal. Although no date has been set, it is assumed an oil and gas lease sale would take place, if authorized by this plan, within the next several years. The area that would be available for oil and gas leasing under the various alternatives is shown in Table IV.A-1(a); the size of other survey, geographic, and manmade features and their areal relationship to the alternatives is shown in Table IV.A-1(b).

The analysis of the various areas proposed as alternatives for oil and gas leasing in the Northeast NPR-A Planning Area IAP initially focuses on the potential effects of the first lease sale. This analysis is based on (1) present-day knowledge about the physical characteristics, biological resources, and social systems described in Section III of this IAP/EIS; (2) petroleum resources as estimated from current geological and geophysical data (Sec. III.A.1.a(3)); and (3) scenario assumptions that have been hypothesized using current North Slope petroleum-industry technologies and infrastructure (Sec. IV.A.1.b). The levels of activities in the scenario assumptions are based on the estimated ranges of petroleum resources. Given the assumptions that are part of the analysis, the focus on the initial sale provides the best estimate of the potential effects that oil and gas leasing might have in the reasonably foreseeable future.

The analysis of the effects of the IAP focuses on those activities that have some potential impact "on the ground"; these activities are described in Section IV.A.1. For each of the resources analyzed in each of the alternatives and the cumulative case, the analysis for the first sale ends with a conclusion (Conclusion—First Sale); if the potential effects of an alternative on a resource results in a relatively lengthy analysis, the conclusion is preceded by a summary (Summary) of the analysis.

Under Alternatives B through E, the BLM may decide to hold more than one oil and gas lease sale in the planning area. The number of potential sales, the interval between sales, and the period with which the sale may be held are unknown; however sales can be held by tiering off this IAP/EIS so long as the environmental analysis is considered valid. If there are multiple sales in the planning area, the tracts that may be offered will be restricted to the unleased parts of the area made available for leasing by the selected alternative. For each resource under each alternative, the potential effects of multiple sales are analyzed after the analysis of the first sale (follows the Conclusion—First Sale) and also ends with a conclusion (Conclusion—Multiple Sales).

Alternatives B, C, D, and E have been developed to reduce the potential risk that oil and gas exploration and development activities might have on the environment in and adjacent to the planning area. The risk reduction could be attained, in part, by designating certain areas, singly or in combination with others, as unavailable for oil and gas leasing. These areas are defined by the Land Use Emphasis Areas (LUEA's) described in Section II. If there is an oil and gas lease sale, Alternative B provides the greatest risk reduction of any of the leasing alternatives by making all the LUEA's unavailable for leasing (Table IV.A-1(a)). Alternatives C and D provide less risk

Table IV.A-1
Areas: (a) Alternatives and (b) Features

(a) Alternatives

Leasing Availability	A Acres (million)	A Percent of Planning Area	B Acres (million)	B Percent of Planning Area	C Acres (million)	C Percent of Planning Area	D Acres (million)	D Percent of Planning Area	E Acres (million)	E Percent of Planning Area
Available	0	0	2.0	43	3.4	74	4.1	89	4.6	100
Unavailable	4.6	100	2.6	57	1.2	26	0.5	11	0	0

(b) Features

	Size			Percent of Land Available for Leasing: Alternatives			
Areal Feature	**Square Miles**	**Acres**	**Percent of Planning Area**	**B (2.0 Million Acres)**	**C (3.4 Million Acres)**	**D (4.2 Million Acres)**	**E (4.6 Million Acres)**
Township	36	23,040	0.51	1.17	0.69	0.56	0.51
Section	1	640	0.01	0.03	0.02	0.02	0.01
Airstrips (150–200 feet wide by 5,000 to 6,000 feet long)[1]	0.03–0.05	20–30	<0.001	0.001–0.002	<0.001	<0.001	<0.001
Field Development Footprint[1]	0.16	100	0.002	0.005	0.003	0.002	0.002
100 – 1,000 acres	0.16–1.56	100–1,000	0.002–0.021	0.005–0.049	0.003–0.03	0.002–0.024	0.002–0.021
8,894 acres[2]	13.83	8,894	0.19	0.44	0.26	0.21	0.19
Teshekpuk Lake[3]	315	201,600	4.38	▨	▨	4.80	4.38
Nuiqsut Lake[3]	12	7,680	0.17	▨	▨	▨	0.17

[1] Appendix A2: Reasonable and Foreseeable Development Scenario
[2] Total onshore area affected by gravel extraction and fill for existing oilfields and planned projects on the North Slope — Table IV.G-1
[3] 105(c) Land Use Study, Physical Profile, 1978

▨ Lake is located in that part of the planning area that is unavailable for leasing under the alternative

reduction than Alternative B by making some of the LUEA's available for leasing. Alternative E makes all of the planning area available for oil and gas leasing.

The final part of the analysis for each resource under each alternative addresses the effectiveness of the stipulations that are incorporated as part of the alternatives (Effectiveness of Stipulations). The potential risk that petroleum development might have on the resources in the planning area also might be reduced through the implementation of the stipulations as described in Section II. Some of these stipulations could eliminate or restrict certain types of activities in areas available for oil and gas leasing. These restraints also could reduce the estimated amount of resources that could be developed by eliminating some potential prospects, especially the smaller ones, from exploration and development consideration.

1. Ground-Impacting-Management Actions:

The ground-impacting-management actions refer to those types of activities that are managed through BLM's regulatory and permitting processes. These activities may have some level of impact "on the ground" in the Northeast NPR-A Planning Area. For the purpose of this IAP/EIS, the ground-impacting activities have been divided into those that are not associated with oil and gas exploration and development and those that are associated with oil and gas exploration and development. The types of activities not associated with oil and gas exploration and development are described in Section IV.A.1.a. The potential effects of these activities are analyzed in Alternative A, the No Action Alternative (Sec. IV.B). The activities associated with oil and gas exploration and development are described in Section IV.A.1.b. The potential effects of oil and gas explorations and development activities are based on discovery and production of four estimated ranges of crude oil and analyzed in Alternatives B, C, D, and E (Secs. IV.C, IV.D, IV.E, and IV.F, respectively).

Table IV.A.1.a-1
Summary of Some Anticipated Non-Oil and Gas Related Management Activities

	ALTERNATIVES				
	A	B	C	D	E
AIRCRAFT USE	(This use does not include that associated directly with oil and gas development or recreation. fixed-wing aircraft and helicopters are used. almost exclusively summer use.)				
Point-to-point	occasionally	regular but not daily	regular but not daily	daily	daily
Wildlife aerial surveys	14 days during June and July	21 days during June and July	21 days during June and July	21 days during June and July	21 days during June and July
Other aerial surveys	occasionally	several 1-2-week periods	several 1-2-week periods	several 2-3-week periods	several 2-3-week periods
EXCAVATION AND COLLECTION	-1 acre disturbed	2 acres disturbed	4 acres disturbed	5 acres disturbed	6 acres disturbed
GROUND ACTIVITIES	(These camps do not include those associated directly with oil and gas development or recreation use. large camps include -15 persons and may have 5,000 gallons of fuel. Umiat, Lonely, Ingok, and the Ikpikpuk well-site are likely locations for large camps. all camps occur in summer.)				
Large camps	6 weeks	12 weeks	12 weeks	12 weeks	12 weeks
Small camps	3 weeks	6-12 weeks	6-12 weeks	6-12 weeks	6-12 weeks
RECREATION	(Colville River float-trip parties, typically 4 persons per party. SRP=Special Recreation Permits, i.e., guided, regulated by BLM.)				
Above Umiat	6 with SRP's 3 casual parties	7 with SRP's 8 casual parties	7 with SRP's 8 casual parties	7 with SRP's 8 casual parties	6 with SRP's 3 casual parties
Below Umiat	4 with SRP's 1 casual party	9 with SRP's 6 casual parties	9 with SRP's 6 casual parties	9 with SRP's 6 casual parties	8 with SRP's 5 casual parties

a. Activities Other Than Oil and Gas Exploration and Development: The following are activities other than oil and gas exploration and development that BLM may undertake or authorize within the planning area that could have impacts on surface resources. A generic description is given of the types of activities that may occur, the general location where the potentially impacting activity would be likely to occur, the time of year of the activity, and estimates of the frequency of such actions. Table IV.A.1.a summarizes the amount of some of these activities anticipated under each of the alternatives.

(1) Aircraft Use: Light helicopters commonly are used to examine resources in the planning area. Less frequently, people fly light, fixed-wing aircraft. Medium fixed-wing and medium helicopters occasionally are used; heavy helicopter use is extremely rare. These aircraft transport people, supplies, and equipment for fieldwork and fly aerial surveys.

Helicopters normally fly low and slow. They have a negligible physical impact on the ground, but their noise can have measurable impacts on wildlife behavior. Fixed-wing aircraft produce less noise and usually fly higher and faster. They have a negligible ground impact if landed on established airstrips, on lakes during the summer, or on ice in winter. When used on unimproved landing areas in the summer, however, they can take a toll on vegetation and soils. Point-to-point transportation can be flown to avoid sensitive wildlife and generally is at higher altitudes and of shorter duration over any given area than aerial-survey flying. Therefore, it normally creates less impact on wildlife.

Almost all aircraft activity would be in summer. While aircraft likely will fly over nearly all of the planning area, some areas will receive greater use. Surveying of resources and monitoring human use will concentrate along the Colville and Ikpikpuk rivers. Cultural and paleontological surveys will be most likely to involve aircraft in the central part of the planning area. Aerial wildlife surveys most commonly will occur during late June and early July over caribou and waterfowl areas.

(2) Excavation and Collection: Archaeological, paleontological, geologic, and soils assessment excavation and collection take place in summer. All excavation is by

257

trowel or hand shovel and usually is limited to an area of several square feet (ft) and rarely goes deeper than 3 ft. More extensive areas may be excavated if an archaeological site is being studied in greater detail or if a geologic section is being mapped. Excavations are backfilled and, in most cases, the vegetative layer is replaced atop the excavation. Most of the anticipated excavation probably would occur in the central portion of the planning area.

(3) Ground Activities: Ground activities encompasses such benign activities as small groups of scientists hiking across the land and small groups of recreationists floating along a river. Given the small numbers of such users and the scattered and benign nature of their activity, no impacts are expected from this travel.

Impacts are possible from camps. Camps vary from those associated with an aircraft onsite to those with no more supplies than can be carried in a backpack. The former may include a fuel bladder of up to 5,000 gallons (gal) or fuel in drums and might have approximately 15 persons in the party. Smaller parties use "fly" camps. They are set up and moved every few days or so by boat, raft, or aircraft. They have no more than stove fuel. Backpack camps have even fewer supplies and most commonly are moved daily.

Larger camps most likely would be placed at the Inigok airstrip, the abandoned Ikpikpuk well site in Sec. 25, T.13N., R.10W., Umiat Meridian; the Lonely Distant Early Warning (DEW)-Line site in Sec. 17, T.18N., R.5W., Umiat Meridian; and the Ivotuk airstrip, which is outside the planning area in Sec. 13, T.11S., R.17W., Umiat Meridian. Fuel facilities would be associated with each of these camps and, at some of these sites, a fuel cache might be established without a camp. The use of the Inigok airstrip is likely to be greater in the next few years to support Native Allotment fieldwork and endangered-species monitoring than in subsequent years. Small camps may be placed at locations throughout the planning area.

Vegetation trampling is common to all camps, although it increases with the duration of the camp. Some solid wastes can be burned onsite, but all other waste, including human waste, is removed from all but the fly and backpack camps. Human waste at the latter two camps is disposed of in a manner to render effects negligible, as recommended in the National Outdoor Leadership School's "Leave No Trace, Alaskan Tundra" guidelines.

Caches of drums of aviation fuel commonly are established to facilitate more economic aircraft use. All such caches include spill-cleanup material, and caches with more than 500 gal are within a containment, normally a portable containment dike. Vegetation trampling and small fuel spills are associated with fuel caches.

(4) Hazardous and Solid Material Removal and Remediation: A phased approach will be used to address hazardous- and solid-waste material in the planning area. This includes the verification and site evaluation of uncontrolled releases of hazardous substances on BLM land. The process is consistent with guidance and regulations from the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the National Contingency Plan (NCP).

(a) Discovery and Site Verification: Discovery and site verification is the first phase of the process. The discovery component is when a release or threat of release of a hazardous substance is suspected or has occurred. This information may be generated through an inventory, incidental observation, or report by either the public or another agency.

An initial incident/site examination is performed by trained personnel. This involves the verification of the land ownership and that a release of a hazardous substance is suspected or has occurred. The process involves inspection and verification of existing information and, potentially, the use of helicopter or fixed-wing aircraft to mobilize to the site. Programmatically, 2 to 3 weeks per field season is directed for this kind of activity. Actual time and extent of investigation depends on the number and types of reports or discoveries.

If a release is suspected or has occurred, a risk assessment will be conducted to determine if the situation poses an imminent threat to public health or to sensitive environments. The purpose of this assessment is to determine if the situation warrants immediate action. If so, an emergency response or removal action may be initiated.

If the examination verifies that the release of a reportable quantity of a hazardous substance (40 CFR 302.4) occurred, a threat exists, or a release is suspected, and the situation does not warrant an emergency response, a site evaluation should be conducted. The evaluation process is implemented concurrently with the identification of potential responsible parties (PRP) and cost-avoidance cost-recovery process. When a viable PRP is identified, all remaining actions pertaining to the evaluation and remedies should be completed by the individual responsible under the appropriate Federal and State oversight.

(b) Site evaluation: The objectives of removal evaluations are to determine if a problem exists, identify short-term alternatives to correct the situation, and determine if a remedial evaluation is required for the site. The first step is to document whether the release of a hazardous substance has occurred and identify the potential constituents of concern, principally by the use of nonintrusive samples. Identification of potential targets that may be impacted and pathways by which they may be impacted also is information to be provided. Determining the need and appropriateness of removal actions and whether expanded sampling is required is another component.

Expanded sampling and site characterization generally take about 2 weeks per site. Shovels and hand augers generally are used for this phase of the project. Experience indicates that additional site characterization is warranted in approximately 20 percent of the sites based on analytical results, targets, and pathways of concern. Drill rigs or hydropunches and backhoes for near- surface sampling can be used for studying groundwater and determining the extent of contamination at a site. These advanced studies commonly entail 3 to 4 weeks of field time. Eighty percent of the drilled holes commonly are backfilled immediately. The remaining borings commonly are developed into monitoring wells. Proceeding to a remedial evaluation may be the next investigatory step.

Prioritization for removal actions will focus on areas of greater human contact or biologically sensitive areas. Thus, it is anticipated that most potential removals would occur in the northern part of the planning area and near the Colville River.

A preferred removal alternative minimizes soil disturbance. A fence may be placed around the site to secure it to prevent contact by humans or wildlife. A cap of clean soil or gravel is another measure to minimize contact. Depending on the contaminants, in situ treatments may be a practical alternative.

If necessary, contaminated materials would be excavated and removed for treatment and disposal. Excavation generally would not go deeper than 5 ft below the surface. Disturbed areas would be backfilled and levelled and erosion-control measures engineered. Removal activities would involve the use of heavy equipment such as large and small backhoes, 988-size front-end loaders, bulldozers up to the size of a D-9, dump trucks, pickups, and all-terrain vehicles (ATV's). This type of equipment would be transported overland in winter. A barge may be used, if the site is accessible by water.

Because in many cases cleanup can be accomplished only in summer, a gravel pad or road may be constructed for use during the operation to protect the underlying soil and vegetation. Such a pad may be removed after project completion.

If further investigation is warranted for a site, a remedial site evaluation may be required. The primary objective of the remedial stage is to determine the relative significance of the site in terms of risk to targets and to select permanent solutions for significant sites that are both cost effective and efficient. These studies generally involve more complex situations that require long-term treatments. There are required regulatory timeframes for submission of remedial reports once the process has been initiated, and sites are published in the *Federal Register* (*FR*).

Most hazardous- and solid-material removal and remediation is a lengthy process due in part to the expense involved. The exception is the occasional removal of fuel drums and scrap metal. Government parties in the area for other purposes with a medium helicopter can use a sling to carry these items to appropriate disposal facilities. Substantial funding, however, would be necessary to undertake any cleanup other than this small-scale helicopter removal.

(5) Overland Moves and Other Land Use Permits: The BLM issues permits to authorize overland moves and a variety of other activities in the planning area. Vehicles used in overland moves exert low ground pressure and are permitted to travel only over snow-covered ground frozen to a sufficient depth to minimize soil and vegetation impacts. Overland moves typically occur from Prudhoe Bay or Oliktok Point to Barrow. If conditions allow, travel will be exclusively offshore over ice. If the ice is not safe, portions of the trip will be made overland following the shoreline, though moves farther inland are not precluded. The earliest moves normally commence in December, when there is adequate snow cover and the ground is frozen. The last trips generally end in April. Twenty to one-hundred trains of one to six vehicles and attached sleds travel this route annually. Should oil and gas exploratory drilling and development increase general economic activity on the North Slope, the number of overland moves may tend toward the higher of these numbers. Overland moves associated with oil and gas exploration and development are discussed below in Section IV.A.1.b.

The BLM may issue minimum-impact permits per 43 CFR 2920 for a variety of other uses. For example, the North Slope Borough (NSB) currently is authorized to maintain a wildlife- observation cabin on the north shore of Teshekpuk Lake, accessed by airstrip or boat and used year-round.

(6) Recreation: The BLM issues Special Recreation Permits (SRP's) to commercial recreation operators, such as hunting and float-trip guides, all of whom focus their activity along the Colville River. Under current management, up to three of the permittees, accounting for at most six trips, may float from the headwaters area to Umiat. The trips would be for hunting in August or the first week of September and would consist of about four persons. They probably would not camp within the planning area. Under current management, up to two permittees, accounting for up to four parties of four persons each, may conduct trips below Umiat during the summer to enjoy the scenic, wildlife, and paleontological resources of the Colville. Each party would camp up to three times each in the planning area. A very limited number of SRP's may be associated with other types of use. At least one permittee may operate with floats taking hunters to lakes or sightseers to areas along the Colville River. These flights may result in camping similar to that of fly camps or backpack camps.

Floating parties along the Colville will carry enough fuel for a small stove and their boat engines. They will camp for no more than 1 night in any one place, and their camping practices and likely impacts would be consistent with those of fly camps or backpack camps described above under "Ground Activities."

Alternatives B through E propose a variety of actions that could increase the number of visitors or add new recreational opportunities for current users of the area. Creation of an air park at Umiat and associated loop trails probably would not attract many people to Umiat. The 50 to 75 persons who use the airstrip would, however, benefit from those facilities. Designation of the Colville River area as a Bird Conservation Area or as a part of the Wild and Scenic River (WSR) System would draw new visitors to the Colville. Access to the upper river would be via small airplane from Bettles or Noatak, with landings occurring on gravel bars along the river. Parties interested in only the lower portion of the river could land at Umiat.

b. Oil and Gas Exploration and Development Activities:

(1) Introduction: This section provides a general description of the activities associated with oil and gas operations on the North Slope of Alaska, with particular emphasis on the foreseeable scenarios for future petroleum development in the NPR-A. Activities include conducting seismic operations; constructing ice roads for transporting equipment and supplies for winter drilling of exploration wells; drilling exploration and delineation wells; constructing gravel pads, roads connecting pads, and landing strips; drilling production and service wells; and constructing pipelines. This information will be incorporated into the environmental analyses of the EIS required for future NPR-A leasing programs.

Although the activities described in this report are applicable in a general sense, the actual timing and location of commercial-sized discoveries cannot accurately be predicted. Future petroleum projects in the NPR-A are likely to have special geologic and environmental conditions, and each project could require a unique site-specific approach to development.

The general descriptions of typical petroleum-related activities in northern Alaska are followed by a discussion of possible development scenarios. The fundamental assumption is that the level of activities is directly related to the petroleum-resource potential available for leasing and development. However, industry's interest in exploring for new reserves is highly influenced by profit motives, where opportunities for new production in northern Alaska must compete with projects elsewhere. Consequently, future development activities and their associated impacts are controlled by several factors, including the resource potential of the area, the areas available for leasing, industry's ability to identify exploration prospects, and the competitive interest in exploring for new fields.

Two sets of development scenarios are discussed. The first set includes activities estimated to occur as a result of the next lease sale in the NPR-A. This sale, tentatively scheduled for late 1998, is the first sale in a possible series of future lease sales offering various parts of the NPR-A. The total resource potential and associated development activities are scaled down for this scenario because despite their best efforts, industry is not likely to lease and discover all of the commercial accumulations as a result of a single sale. The second set of development scenarios includes the activities required to develop and produce the total resource potential. This is referred to as the "multiple-sale" scenario. As indicated by the activity projections, a large fraction (half) of the resource production is expected to occur as a result of the first sale in the series, with progressively lower fractions occurring from each subsequent sale. Petroleum-related activities, and associated impacts, are presumed to follow similar trends.

(a) Resource Estimates: Estimates of oil and gas resources provide the basis for identifying high-potential areas for possible leasing and to project reasonable future development scenarios analyzed in environmental impact studies. Surely, other scenarios of hypothetical oil development are possible and equally feasible. At this time, there is no guarantee that leasing will occur in the planning area or that commercial discoveries will be made. However, the National Environmental Policy Act (NEPA) process requires that leasing on these Federal lands must consider the reasonable and foreseeable consequences of the proposed action.

Estimates of undiscovered resources are uncertain for numerous reasons. To account for this uncertainty, resource estimates usually are reported as a range of volumes. A corresponding range of activities is generated to represent reasonable scenarios should leasing take place.

For the next sale in the planning area, oil production could range from 250 to 1,100 million barrels (MMbbl) from one to five commercial fields. This resource estimate represents the range of production under oil prices of $18 to $30 per barrel (in constant dollars). The remaining economic petroleum potential is assumed to be available for discovery and production as a result of subsequent lease sales, which amounts to an additional 250 to 1,100 MMbbl. Other leasing alternatives are more restrictive and have correspondingly lower levels of activities and petroleum production.

(b) Natural Gas: The foreseeable development scenario does not include the transportation and sale of natural gas from the planning area to outside markets. Liquid hydrocarbons (crude oil, with minor amounts of gas-condensate) are considered to be the only viable petroleum commodity developed and marketed within the foreseeable future from the planning area. The reasoning behind this assumption is that there is no existing transportation system to carry gas production from the North Slope to distant foreign and domestic markets. Proven gas reserves on the North Slope approach 35 trillion cubic feet (Tcf), with 23 Tcf present in the Prudhoe Bay field alone (State of Alaska, Dept. of Natural Resources [DNR], 1997).

Perhaps the most likely future gas-transportation system involves a large-diameter gas pipeline from the North Slope to a liquefied natural gas (LNG) processing plant in Valdez, Alaska. Marine LNG carriers would then transport the gas product to distant markets, largely in the Pacific Rim. With an estimated cost approaching $15 billion, the project is uneconomic under current conditions. When such a project is constructed, there are ample gas reserves for decades of production before excess capacity in the system would prompt exploration and development of new gas resources from the planning area.

A new technology, termed "gas-to-liquid" (GTL), can convert natural gas to high-purity "white crude." However, this new technology is untested for large-scale operations such as the North Slope. In the future, GTL technology could be used to produce gas from small, remote fields discovered in the planning area, but this situation is beyond the scope of foreseeable scenarios in the present analysis.

Without a large, outside market for gas production, new gas discoveries are likely to be "shut-in" (abandoned for an undetermined period), and gas recovered as a byproduct of oil production will be used as fuel for facilities or pumped back into reservoirs to increase oil recovery. Reinjected gas would not be lost as a resource, but gas sales to outside markets would be postponed.

(2) Petroleum Operations under Arctic Conditions:

(a) Past Experience: Oil and gas operations under arctic conditions date back more than 50 years. Early exploration in Northern Canada resulted in the oil discovery at Norman Wells in 1920, which has been produced intermittently to the present time. The Umiat oilfield, located in the southern part of the planning area, was discovered during exploration by the U.S. Navy in 1946 and remains noncommercial today. Extensive exploration in the 1960's resulted in numerous oil and gas discoveries in both northern Alaska and the adjacent Mackenzie Delta in Canada. The largest of these, Prudhoe Bay, was discovered in 1968, with nearly 13 billion barrels (Bbbl) of recoverable oil. After construction of the Trans-Alaska Pipeline System (TAPS) in 1977, oil discoveries on the North Slope were brought into production. The most recent, and perhaps important oil-development project to the NPR-A is the Alpine field in the Colville River delta, which is scheduled for production startup in the year 2000.

Information from decades of experience in arctic exploration, development, and production operations is contained in a variety of government and industry reports. No attempt is made here to cite all literature relevant to the NPR-A, but readers are directed to excellent documentation provided in the 105 Policy Analysis Reports generated for the previous NPR-A leasing (USDOI, BLM, 1979), an operational history of government-sponsored exploration in the NPR-A (Schindler, 1988), the Draft Arctic National Wildlife Refuge (ANWR) Resource Assessment Report for technology and operational aspects of the eastern North Slope (USDOI, 1986), and the Alpine Environmental Evaluation Document containing detailed descriptions of current project designs for a sensitive arctic environment (ARCO Alaska, Inc., 1996).

(b) Technology Advancement: It is important to recognize that numerous technological advancements have been made during the decades of operations on the North Slope, allowing current development activities to proceed at far lower cost and with less environmental impact than previous operations. It has become apparent that lower levels of impact, such as smaller areal footprints for production facilities, translate directly into lower overall development costs. Some of these advancements are listed below, and others will be discussed under subsequent headings of this report.

- Drilling-pad footprints have been reduced more than (>) 80 percent from older pad designs by closer well spacings and eliminating mud-reserve pits (tanks replace pits).
- Roadless development is possible because of improvements in ice-road construction. Winter

261

Table IV.A.1.b-1
Development Timeframe for a Typical Oilfield

Project Phase	Length of Activity (Years)	Activities
Exploration	1-10 following lease sale	–seismic surveys to define prospects –well-site surveys and permitting –drill exploration wells
Discovery	2-5	–produceable well determination –drill delineation well(s) –additional seismic survey (3-D) –reservoir appraisal and engineering studies –project design and environmental studies –permit applications
Development	2-5	–establish construction base camp –set up environmental monitoring programs –install gravel pads for facilities –design and build production modules –begin drilling development wells –install pipelines and pump stations –install production facilities and hookup
Production	10-30	–continue development-well drilling –production rampup (2-5 years) –peak production plateau (3-8 years) –production declines –well workovers (every 3-5 years) –infill drilling (well spacing reduced) –tertiary recovery methods employed –wells progressively shut in –economic limit reached
Abandonment	2-5	–plug and abandon wells –remove production equipment –dismantle facilities –decommission pipeline –site restoration and revegetation –phase out environmental monitoring

exploration drilling from ice pads minimizes long-term impacts to the tundra surface.

- Spent drilling fluids and rock cuttings are disposed of in wells. There is no surface discharge of drilling fluids or dumping of drilling wastes.
- Reservoir targets miles away from the surface pad can be tapped by extended-reach wells. Fewer drilling pads are needed to develop subsurface reservoirs.
- Multiple completions can be made from a single wellbore to increase well productivity and reduce the number of surface wellheads. Fewer wellheads allows a reduction in pad- footprint area.
- Advanced seismic-data acquisition and interpretation (3-D seismic workstations) results in better drilling efficiencies (fewer dry holes, better pad placement, higher recoveries).

(c) Timeframe for Activities: To place the descriptions of petroleum-related activities in a time context, a generalized schedule for a typical development project in a remote area of the North Slope is offered in Table IV.A.1.b-1. This example indicates that discoveries of commercial fields could take place at any time within a 10-year period (standard lease term) following the sale. Delineation and development activities could take from 4 to 10 years prior to production startup. Production activities would last between 10 and 30 years, depending on field size. Abandonment activities, including well sealing and site restoration, could last 2 to 5 years more after production ends. This representative timeframe suggests that new oil production should not be expected for at least 5 years following the lease sale, and it is more likely that 8 to 12 years will elapse before production begins from leases sold in the next NPR-A sale. The roads, where the tundra surface is flooded with water to build up progressive layers of ice. As with ice roads, the use of aggregate chips speeds the process while decreasing water demands. A typical ice pad is designed to be a minimum of 1.0 ft thick, covers 6 acres, and requires approximately 500,000 gal of water to construct. Depending on the well site, ice pads could range in size from 3 to 10 acres. Water requirements vary, depending on the pad size and availability of aggregate chips shaved from nearby lakes.

New designs for ice-pad construction have allowed pads to remain intact over the summer season and to be reused for drilling the following winter, saving both time and cost. As this technology improves with experience, it may be possible to construct ice pads to serve as year-round drilling platforms or for long-term production facilities. Although theoretically possible, no such technology has been demonstrated for long-term occupancy.

(b) Seismic Surveys: Seismic-survey work is likely to continue at present levels in the NPR-A and may increase somewhat should a multiple-sale leasing program be initiated. Additional seismic-data collection is justified for several reasons: (1) to provide a closer grid spacing for more subsurface detail; (2) to acquire new data using advanced techniques for better resolution of subtle geologic features and stratigraphy; and (3) to delineate fields discovered by exploration wells (usually 3-D seismic).

In contrast to early seismic programs that used dynamite in shot holes as the energy source, seismic programs now use vibrator equipment (Vibroseis) to generate energy into the subsurface. This newer technique provides high-quality data with minimal disturbance to the area.

Typically, three to four seismic crews are active on the North Slope each winter, and one to two crews could be expected to collect seismic data in the northern NPR-A in future winter seasons. A 2-D seismic party typically consists of 40 to 60 persons and can collect 5 to 10 line-miles of seismic data per day. A more closely spaced 3-D seismic program typically consists of 60 to 100 persons and can collect 2 to 4 square miles (mi^2) of data per day. However, winter weather is a constant factor affecting visibility and crew safety, and time is lost in mobilization, camp moves, and downtime during storms. Considering these logistical problems, one 2-D seismic crew typically could collect 250 line-miles of data in one winter season. A 3-D seismic crew typically could collect 150 mi^2 of data in one winter season.

Seismic crews are housed in mobile camps consisting of a "cat train" of trailer sleds pulled by tractors. Seismic-data-collection operations are conducted by all-terrain, low ground-pressure vehicles (both wheel and articulated-track designs). Camp supplies (food, fuel) are transported to the survey area by both ground vehicles and light, fixed-wing aircraft.

For additional discussion of the scenario for seismic activities under the various alternatives, see Section IV.a.1.(b)(2).

(c) Exploration and Delineation Wells: Drilling is the only reliable method of verifying the presence of oil in a prospect mapped using seismic data or of obtaining direct information on subsurface reservoir conditions. Exploration operations require moving heavy equipment (a drill rig) and large amounts of materials (steel casing, drilling mud, fuel) to remote locations. Equipment and materials are typically moved to remote drill sites on purpose-built ice roads in midwinter months. Transportation logistics to the drill site also must allow for regular crew changes and resupply. An exploration well crew could consist of 30 to 60 persons, working 1- to 2-week shifts, and transported to the site by aircraft landing on constructed ice runways. Large lakes (1 mi across or more) can quickly be prepared as winter landing strips.

Exploration wells in the northern portion of the planning area (the area of highest oil potential) are likely to range from 6,000 to 12,000 ft in depth. For these depths, most exploration wells can be drilled, logged, and tested within a single winter season. If a discovery is made, a second (delineation) well could be drilled from the same ice pad in a single season, depending on well depth and the efficiency of drilling operations.

To define the limits of reservoirs after a discovery is made, several delineation/appraisal wells are likely to be drilled before a commitment is made towards project development. Additional delineation wells surrounding the discovery well would be planned for the following winter, probably using a new ice pad. Because of high project costs, two to four successful delineation wells may be drilled to define the drainage area of each production pad. For example, a typical field-development project consisting of two production well pads would require a total of seven wells (1 exploration and 6 delineation wells). Delineation-well drilling is likely to be coordinated with a 3-D seismic survey.

When reservoir testing is completed, all wells will be plugged and abandoned. Cement plugs will be placed in deep zones capable of flowing hydrocarbons and in the near-surface section of the wellbore to prevent migration of fluids. Successful wells (discoveries) may be re-entered and used as production wells at a later time by drilling out the cement plugs, but most exploration wells will be considered "expendable" (not used for production). If a discovery is made, equipment and materials may be left at the site, supported on pilings (or "sleepers"), to reduce mobilization time the following the winter drilling season. Rock cuttings from delineation wells could be either backhauled to existing disposal wells or processed (ground and treated) for subsurface disposal in the abandoned test wells. Upon completion of drilling operations, all equipment and materials would be moved back along ice roads to staging areas. No materials or drilling wastes (mud and cuttings) would remain at the site.

(d) Water Demand and Rock Cuttings: Drilling operations require large amounts of water for blending into drilling mud. These operations also produce large amounts of rock cuttings. For example, a 10,000 ft well could require approximately 850,000 gal of water for drilling in addition to approximately 100 gal per day for each person in the drilling crew (for camp use). Over a typical 4-month drilling season, a one-well drilling operation could require a total of 1,650,000 gal of water obtained (if possible) from a source close to the well site. The use of melted snow could supplement this water requirement. Estimated water requirements are much less for delineation wells, because approximately 80 percent of the drilling mud will be reconditioned and reused.

A typical 10,000 ft well could use 630 tons of drilling mud and produce 820 tons of rock cuttings. The use of slim-hole drilling techniques for exploration wells could greatly decrease both the materials required and cuttings produced. For comparison, slim-hole wells have diameters of 3⅞ in to 4¾ in, whereas conventional wellbores are drilled with bits ranging from 8½ in to 26 in.

(4) Development:

(a) Field Layout: After a field has been discovered and confirmed to be of commercial size by delineation wells and seismic surveys, a number of construction activities are required to establish a permanent production operation. A list of typical activities is provided in Table IV.A.1.b-1, and the project layout for the Alpine field is provided in Figure IV.A.1.b-1 as an example of current North Slope development plans. This example field will contain 2 production well pads with a total of 100 to 150 wellheads, a pipeline gathering system to a central processing facility, a 3-mi infield road, a crew support camp, and an airstrip. The Alpine field is not connected to other North Slope infrastructure by an all-season gravel road but will use winter ice roads to move heavy equipment and materials. Light loads, such as camp supplies and crew changes, will use fixed-wing aircraft. This concept of "roadless development" is likely to be chosen for most future fields in the NPR-A for both practicality and cost reasons.

(b) Staging Areas: All materials and equipment necessary to develop a new field must be stockpiled, moved, and assembled in remote portions of the NPR-A and are subject to seasonal constraints to transportation. Consequently, staging areas are very important components to development. Ideally, a staging area contains buildings for warehouses and crew quarters, gravel pads for stockpiling materials, and a serviceable airstrip. If located on the coastline, a causeway or dock is needed for loading materials and equipment transported by barges.

Considering the expense to establish a new staging area in a remote site, it is more cost effective to reoccupy existing sites, even if some refurbishing is necessary. Figure IV.A.1.b-2 shows sites in the NPR-A that could be used as staging areas. Both Camp Lonely and Umiat were used as major staging areas for past NPR-A operations. Additional sites, including previous Husky/USGS wellsites or abandoned DEW-Line sites, could be used as future staging areas to serve future NPR-A development.

It is likely that most NPR-A operations will be initially staged out of Prudhoe Bay Unit (PBU) or the KRU basecamps. Both of these basecamps have all-season airports and are connected by road systems. They also have marine loading sites on the coast (West Dock and Oliktok Point). Materials and equipment likely would be moved to staging areas within the NPR-A by marine transport in the summer months and by trucks in the winter months over ice roads. Aircraft could access remote sites in all times of the year; however, air traffic often is restricted by low clouds and fog in the summer and storms with whiteout conditions in winter.

After the tundra is sufficiently frozen, ice roads would be constructed to the development site. Earth-moving equipment would then move gravel to the site to establish a remote construction camp and all-season airstrip. Later, drilling equipment and supplies would be moved to the site over ice roads. Production equipment (modules) and pipeline-construction materials would be moved during the final stages of development. The overall development phase, from construction of a staging area and remote base camp to production startup, could take 2 to 5 years, depending on the size and location of the new field.

(c) Gravel Requirements: Much of the initial work for a new project will involve the construction of gravel pads for wellheads, production and support facilities, infield roads, and an airstrip. The development area must be level, stable, and elevated above the wet tundra surface. Because the tundra surface is unstable, subject to flooding in summer and ice jacking forces in winter, pads are designed to be at least 5 ft above the tundra surface.

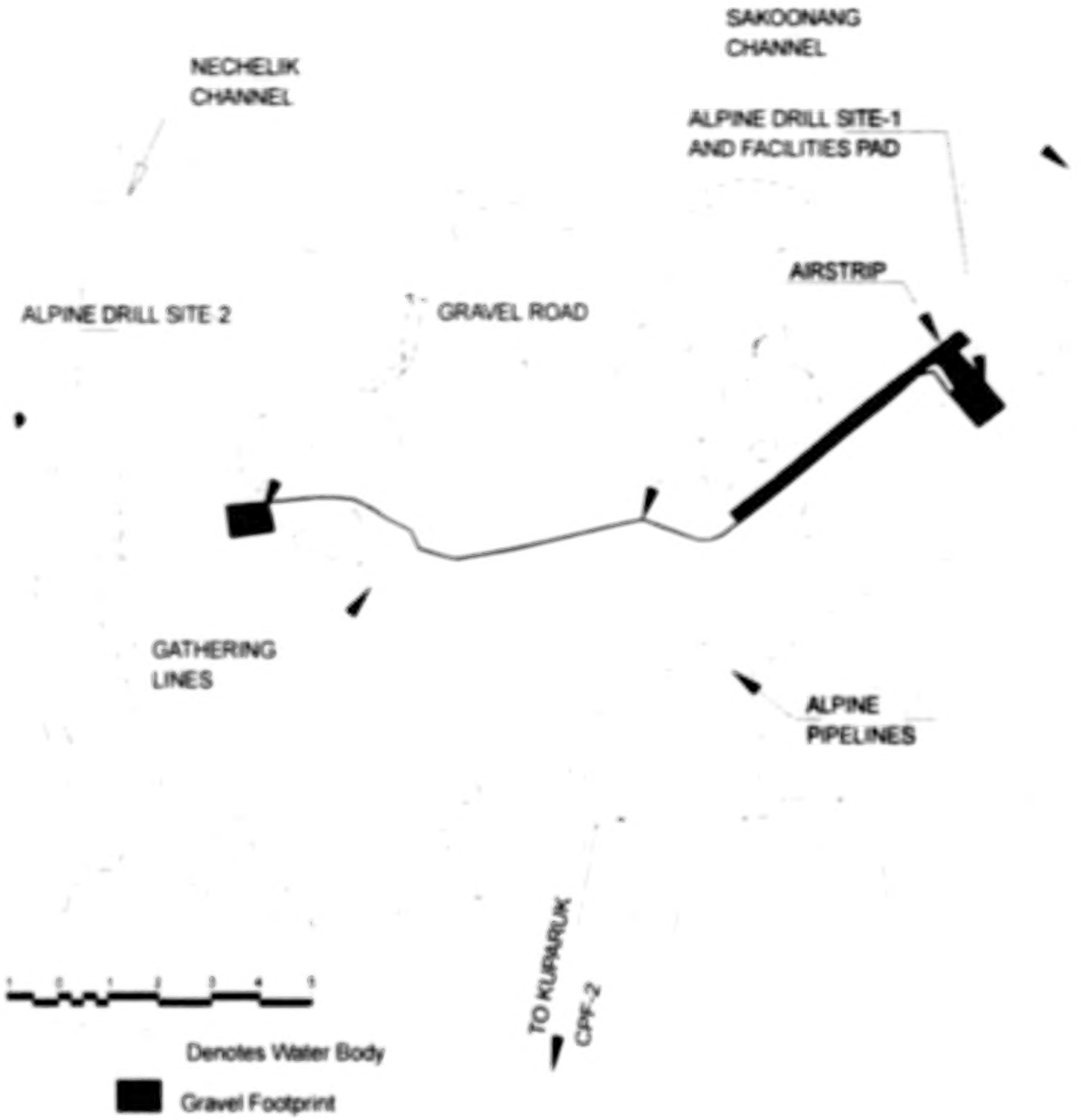
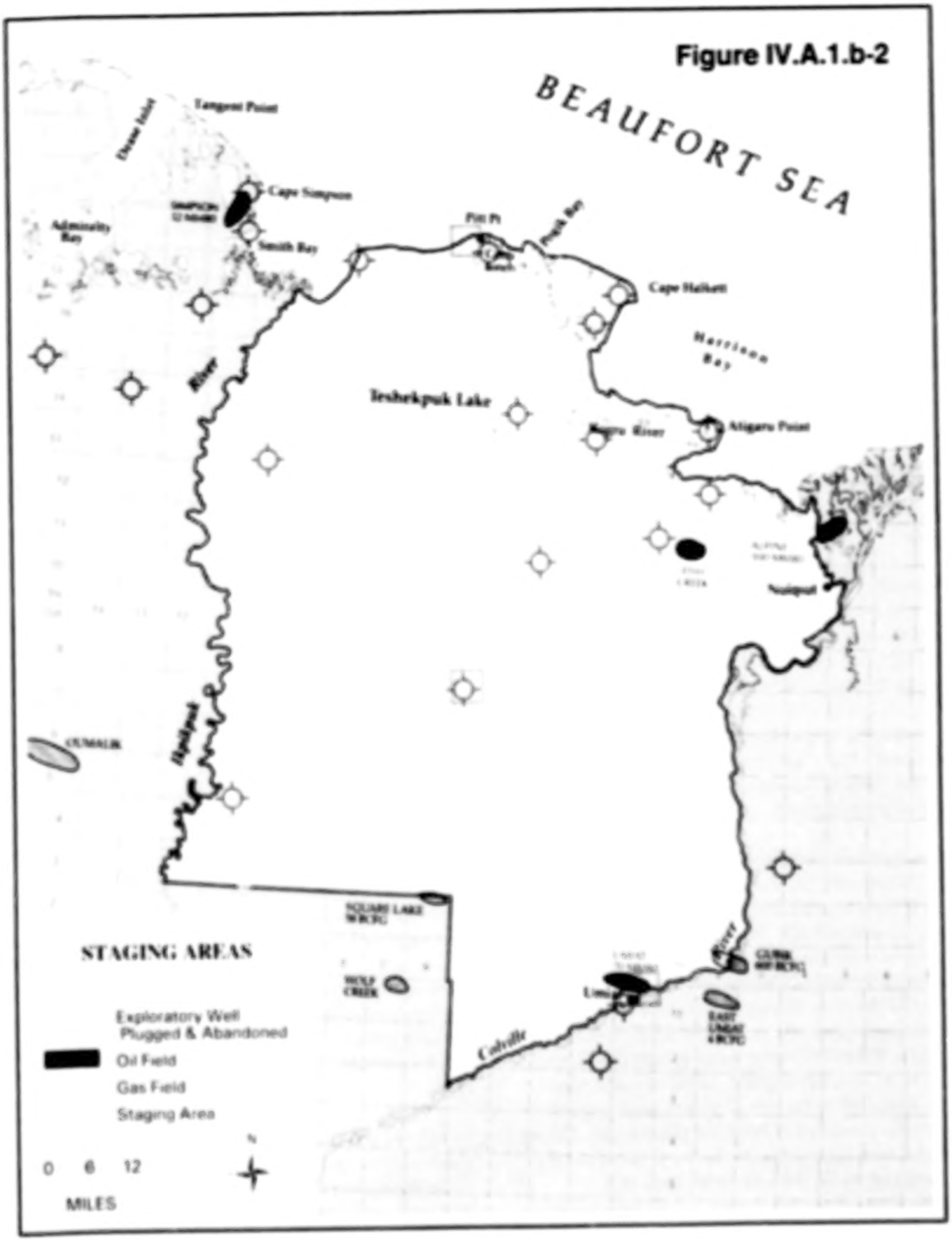


Figure IV.A.1.b-1. Layout of Alpine Field. ARCO's new development project in the Colville River delta could serve as model for future production facilities in NPR-A. The total surface footprint covers 114 acres, which is less than 1 percent of the subsurface drainage area for this 365-million-barrel field. (Figure is from Alpine Development Project: Environmental Evaluation Document, courtesy of ARCO Alaska, Inc.)

Figure IV.A.1.b-2



BEST COPY AVAILABLE

267

Gravel is the preferred material for pad construction, and gravel borrow pits are relatively common east of the Colville River. For developments in the NPR-A, however, gravel is a very scarce commodity; and alternate construction designs likely will be adopted for both practicality and cost reasons. Several types of gravel pads used previously in NPR-A drilling are shown in Figure IV.A.1.b-3. For permanent production facilities, pads made up entirely of gravel are the preferred design, but composite pads are a proven alternative (Kachadoorian and Frederick, 1988).

Gravel requirements for typical "all-gravel" pads rising 5 ft or more above a wet tundra surface are approximately 8,000 to 12,000 cubic yards (yd^3) per acre of surface footprint. Gravel roads (typically 35 ft wide plus 2:1 slopes) cover approximately 5 to 6 acres per mile, and require 30,000 to 50,000 yd^3 per mile. Airstrips (typically 150-200 ft wide and 5,000-6,000 ft long) cover 20 to 30 acres and could require 140,000 to 300,000 yd^3 of gravel. Total gravel estimates for the Alpine field, with a footprint of 100 acres, is approximately 1,000,000 yd^3. Using Alpine as a typical example for future NPR-A development, estimated gravel requirements for drilling and production facilities would average about 10,000 yd^3 per acre of footprint.

Total gravel requirements for future NPR-A developments can be estimated using the assumed amount of 10,000 yd^3 per acre and an average footprint for a midsized field (200-400 MMbbl) of 100 acres. For the maximum development case under the single-sale scenario, corresponding to oil resources of 250 to 1,100 MMbbl (1-5 oilfields), gravel requirements for all-gravel pads would range from approximately 1 to 5 million yd^3. Other leasing alternatives with lower levels of development would require proportionally less gravel.

Gravel requirements could be significantly reduced by "all-season" (composite) pad designs, in which the lower portion of pads are built using blended (or "geotextured") mixtures of sand and silt. This lower lift is overlain by rigid foam (Styrofoam) insulation boards and then covered by a layer (2 ft thick) of clean gravel (Fig. IV.A.1.b-3). Material for the lower portion of pads is common in surficial deposits throughout the NPR-A and could be extracted and blended during winter months from borrow areas near the development site. Using all-season pad designs could reduce the overall gravel requirement to 33 to 50 percent compared to all-gravel pad designs. The use of blended sand-silt mixture for the lower portion of the composite pad would enhance reclamation after abandonment by providing a more natural substrate for revegetation.

Gravel used for developments in the northeastern part of the planning area probably will be extracted from existing borrow sites east of the NPR-A and then transported to the development sites by trucks over winter ice roads. For more distant sites in the central and western part of the planning area, gravel could be collected from existing barrow pits and barged to coastal staging areas, where stockpiles later could be transported to inland locations by trucks over winter ice roads. Pad material also could be extracted from new sites within the planning area (locations are unknown at this time). For new sites, overburden removal and sand/gravel mining could impact areas of 20 to 50 acres, depending on the thickness of the deposit and amount of material extracted. Gravel could also be scavenged from previous USGS Husky drillsites scattered throughout the NPR-A (Fig. IV.A.1.b-2).

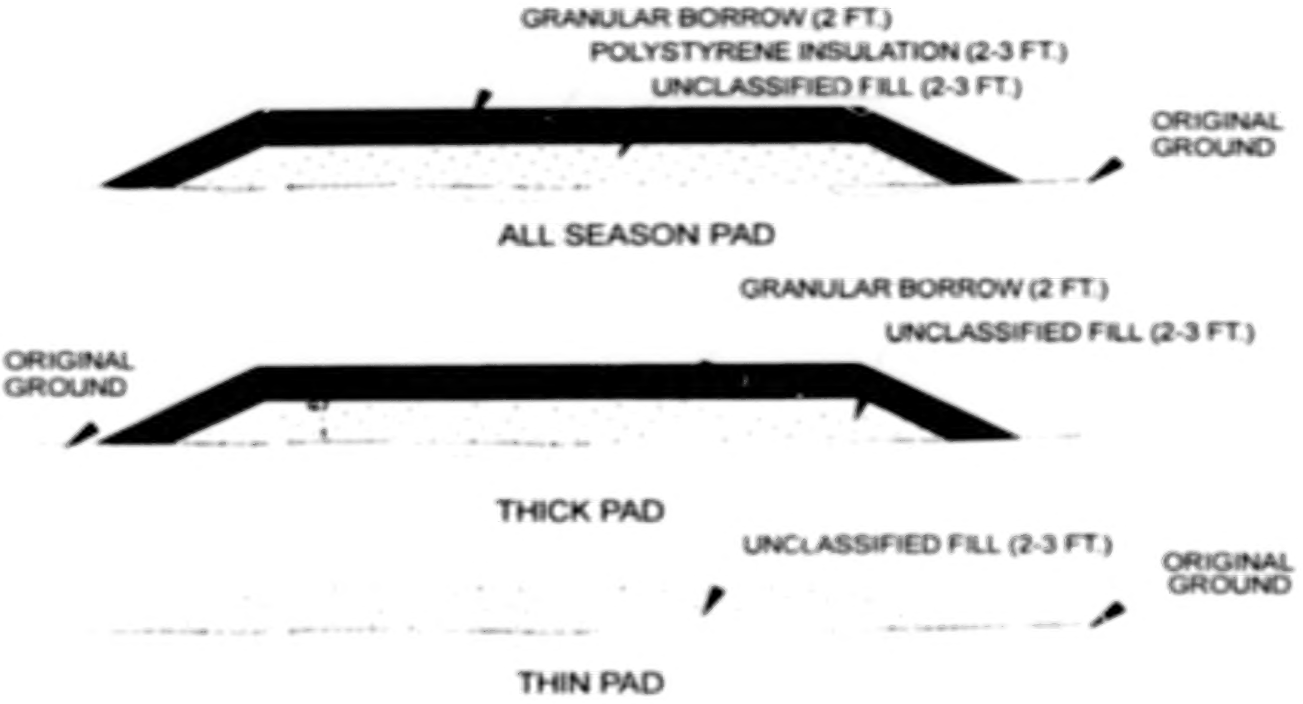
Gravel sources are a major problem for sites in the southern part of the planning area. Surficial gravel sources are rare outside river corridors, so alternative materials are likely to be considered. Bedrock outcrops could be blasted and then crushed and blended with sand to make up suitable construction material. Unconsolidated sand and gravel are available in the riverbed and banks of the Colville River, but restrictions on extraction are likely. Gravel trucking on long ice roads will add significantly to the cost of developments in the southern portion of the planning area.

(d) **Development-Well Drilling**: Production-well drilling is a major activity in developing a new field. The number of production wells is controlled by unique characteristics of the reservoir, including thickness, permeability, lateral continuity (among others). Generally, well-drainage areas range from 40 to 160 acres where thicker, high-quality reservoirs tend to have wider spacing. Thinner or more laterally discontinuous reservoirs normally require closer well spacing. Horizontal completions, with long lateral sections drilled through the reservoir zone, can replace several closely spaced vertical wells. Later in the life cycle of a field, well spacing typically is reduced by infill drilling in the attempt to capture more reserves.

Reservoir-well spacing should not be confused with the surface spacing between wellheads on pads. The spacing between surface wellheads has been reduced from 120 to 160 ft (2 decades ago) to 10 to 20 ft (today) in North Slope fields.

In addition to production wells, other wells are drilled to inject water or gas into the field to maximize oil recovery. These wells generally are referred to as service (or injection) wells. Numerous injection wells are required for waterflood programs, which are routinely used throughout the production cycle to maintain reservoir pressure. The proportion of producer to service wells can vary for each

268



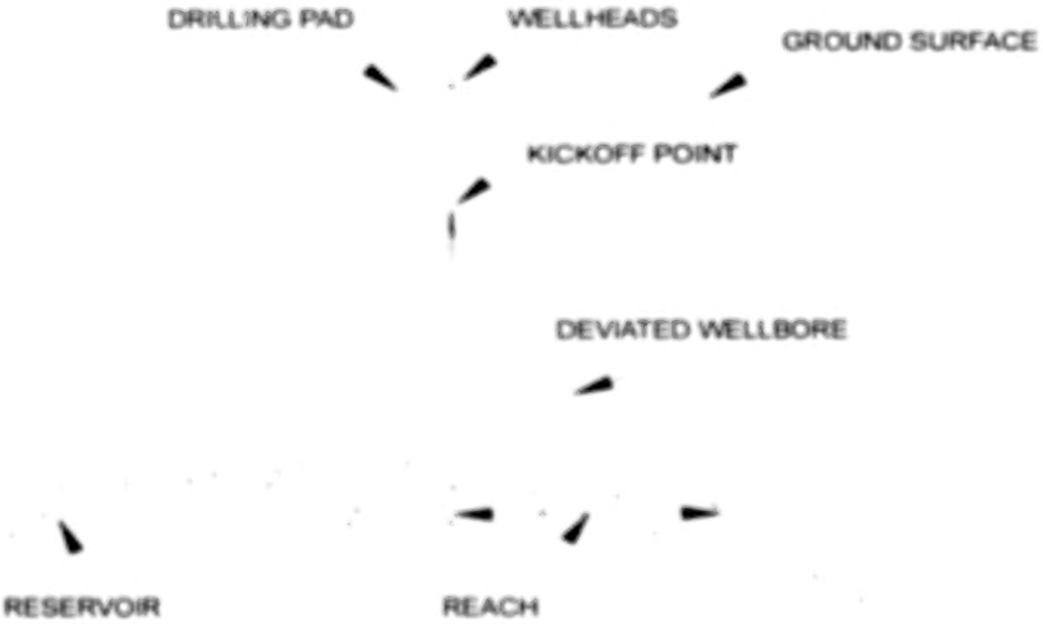


Figure IV.A.1.b-3 (top). Gravel Pad Construction Designs. Elevated pads are essential for all-season operations on the poorly drained tundra of NPR-A. Gravel is the preferred material because of its stability; however, known gravel sources are scarce west of the Colville River. Alternative designs using gravel as a topping material could greatly reduce gravel demands. All-season ice pads have been proposed, but not demonstrated, as a feasible alternative pad design.

Figure IV.A.1.b-4 (bottom). Directional Drilling From a Surface Location. Wells deviated from vertical are standard practice in field development. Conventional wells have reach (horizontal deviation) to depth (vertical) ratios of 1:1. New technology, called *extended reach drilling*, can drill wells to even more distant reservoir targets. Currently, the highest reach-to-depth ratio on the North Slope is 2:1 (Niakuk field, 18,098-ft reach).

field, but a typical ratio of producers to service wells is 2:1 (or one-third of the total wells are nonproducing service wells).

The number of wellheads that could be contained on a single production pad is potentially unlimited, but in practice it is constrained by factors such as reservoir depth and well cost. Most production wells are deviated from vertical to reach subsurface targets at various distances from the production pad (Fig. IV.A.1.b-4). By informal definition, conventional wells have departures (or step-outs) approximately equal to the depth of the reservoir (or 1:1 reach-to-depth ratio). Extended-reach wells have step-out ratios of 1:2 or more. Current state-of-the-art drilling technology, under optimum conditions, can drill wells to reach distances of four times the subsurface depth (4:1 reach-to-depth ratio).

Commonly, extended-reach wells are employed to reach distant reservoir targets from existing facilities or to avoid surface constraints. For example, the extended-reach record on the North Slope is a well in the Niakuk field which reaches 18,098 ft to a reservoir at 9,545-ft depth (about 2:1 reach-to-depth ratio). In this case, extended-reach wells are used to reach a reservoir target several miles offshore, allowing field development from an onshore site and eliminating the need for a new offshore production island.

Over the past decade, worldwide experience has progressively increased the technology of drilling extended-reach wells. However, there are physical limitations, including topside rig power (torque), drillpipe strength, downhole frictional forces (drag), and stratigraphy (such as coal beds), which limit the capability of extended-reach wells. The cost of extended-reach wells is considerably higher, largely because of greater distance drilled (measured depth) and problems encountered involving wellbore stability. Alternatives for field design consider the cost tradeoffs between fewer pads with more extended-reach wells as opposed to more pads containing conventional wells.

Because conventional wells generally are more economical than extended-reach wells, production pads are likely to be spaced at distances from each other of approximately two times the reservoir depth. For example, a reservoir at 8,000 ft requiring two production pads normally would set the pads approximately 16,000 ft apart (3 mi). Assuming an 8,000-ft step-out radius, approximately 4,600 acres (7.2 mi^2) could be drained from each pad. If each well has a subsurface drainage area of 160 acres, a typical production pad would hold 29 producer wells and 15 service wells, for a total of 44 wellheads. Extra space normally would be allocated for additional infill production wells. Pads designed to hold a maximum of 60 to 80 wellheads would have surface footprints of about 10 acres, although the actual number of wells on a pad will vary according to field characteristics. Conventional, directionally drilled wells can reach wider areas of deeper reservoirs, so fewer pads (with more wells) are needed to produce deeper reservoirs. In contrast, shallow fields usually require more pads with fewer wells per pad, although extended-reach wells could be used to drain larger areas in shallow reservoirs. Well planning for field development requires site-specific engineering.

The time required to drill and complete a production well depends largely on the measured depth of the well. Current drilling activities on the North Slope normally take approximately 20 to 30 days to drill and complete a 10,000 ft well. This equates to approximately 12 to 18 wells per rig in a 12-month period. Safety considerations normally restrict operations to one rig drilling on each pad at a time. Using the above example, where 44 wells from each pad are needed to for initial reservoir development, drilling operations would take 3 to 4 years to complete. Seasonal restrictions on drilling operations will increase the overall time to develop a field and could adversely affect the economic viability of the project. Another key consideration is the pressure regime and flow dynamics of oil reservoirs. Once production begins the dynamic balance must be maintained to optimize oil recovery. Discontinuous production drilling is not a normal engineering practice.

(e) Drilling Mud and Rock Cuttings: Drilling operations for each development well requires large amounts of drilling mud and produces large quantities of rock cuttings. Estimates given previously for exploration/delineation wells could also accurately represent development wells of equivalent depths.

New techniques have been refined during the past decade or so on the North Slope to efficiently dispose of drilling wastes (mud and cuttings) in existing wells. Figure IV.A.1.b-5 is a diagram showing the preparation steps before subsurface disposal of drilling mud and rock cuttings. The goal of current North Slope drilling operations is zero surface discharge of wastes. Figure IV.A.1.b-6 is a sketch of a well profile with injection of drilling wastes into shallow, high permeability formations. Generally, dedicated disposal wells are used for injection of drilling wastes, although it is possible to inject wastes into shallow annulus portions of production wells while allowing oil production from deeper zones. Reconditioning and reuse of up to 80 percent of the drilling mud saves costs for both materials and disposal. Clean sand and gravel processed from well cuttings can be recycled and used for pad and gravel road maintenance.

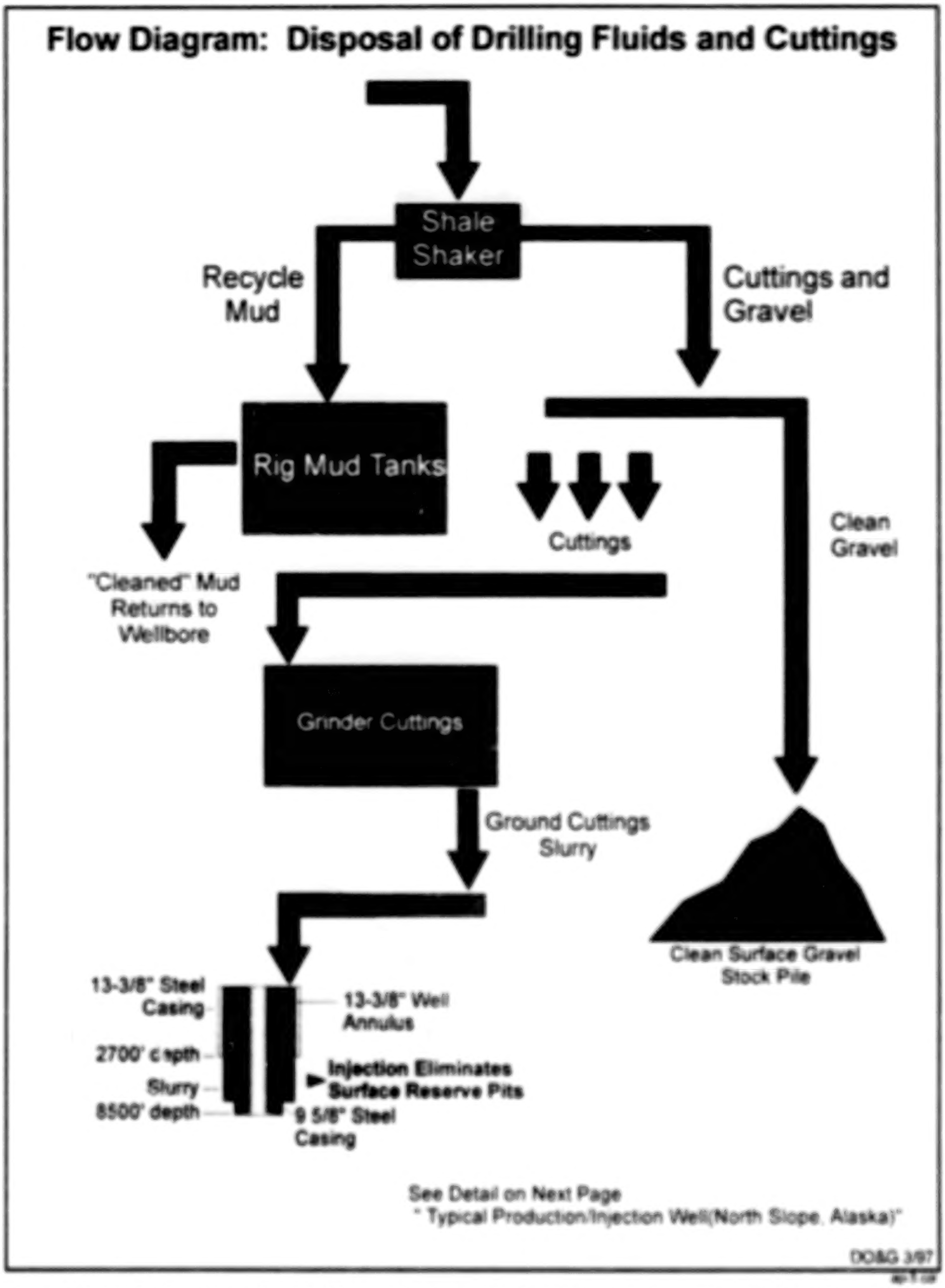


Figure IV.A.1.b-5. Processing Drilling Mud and Cuttings for Disposal. Current approved practices on the North Slope dispose of drilling wastes in shallow portions of production wells. Several steps are taken to recondition drilling mud and recycle rock cuttings to minimize surface disposal of these waste products. (Figure courtesy of ADNR.)

Generally, all wastewater, spent fluids, and chemicals are disposed off site in U.S. Environmental Protection Agency (USEPA)-approved injection wells. Solid wastes are incinerated and hauled to approved offsite landfills. Normal practices do not allow onsite burial of solid wastes.

(f) Water Demand: Water is needed for both drilling and camp use. For the construction phase of the Alpine field, water demand was estimated to be 100 gal/day per person (ARCO Alaska, Inc., 1996). With 350 persons working on the project, the potable water requirement is 35,000 gal per day. Drilling water demand is estimated at 21,000 to 63,000 gal/day. The total water demand over one winter season (mid-November to mid-April, or 150 days) is then 8.4 to 14.7 million gal.

This quantity of water is more easily visualized by comparing it to the drawdown of a lake ½-mi across. Assuming the lake is circular, its surface area is 125 acres. Total water demand of 12 million gal equates to 36.8 acres-feet, so the example lake would have a drawdown of 3½ in to meet the seasonal demand. Recharge to the lake could be expected from snow melting and surface runoff each spring. Local surface water sources (streams and lakes) could be supplemented by camp "snow melters" to meet water demand.

Potable water demand would drop after two to four seasons, when the major construction phase is finished. Only 20 to 40 persons are onsite during the subsequent production phase, and potable water demand would be one-tenth of the development phase. Likewise, drilling-water demand over the 20 years of the field production life (largely for workover operations and infill drilling) is likely to be less than the lower value (21,000 gal/day).

(5) Production:

(a) Production Facilities: A central production facility (or CPF) serves as the operational center for long-term production activities in an oilfield. In addition to oil-production equipment, the CPF typically includes living quarters and offices, maintenance shops, storage tanks for fuel and water, power generators, waste-treatment units, and a communications center. For most North Slope projects, many components of the CPF are constructed as transportable modules in offsite locations, perhaps outside Alaska, then moved over winter ice roads to the field and assembled. All buildings are supported on pilings to accommodate ground settling or frost heaving. An airstrip is usually located near the CPF to allow transport of supplies and personnel to the field site.

Oil-production equipment includes three-phase separators (oil, gas, and water are produced in varying proportions from each well), gas conditioning (natural gas liquids are stripped from produced gas), complex pipeline-gathering and pressure-regulation systems, and well-monitoring and -control systems. Oil from production wells is filtered (to remove sand) and processed (removing water and gas) before being piped through a sales meter and into the sales-oil pipeline system. Gas is processed (to remove liquids), pressurized (compressed), and reinjected into the reservoir through service wells. Likewise, water is processed (chemically treated) and then reinjected into the reservoir for pressure maintenance. Reinjection of produced gas and water increases oil recovery, and this practice is normally initiated from the onset of production.

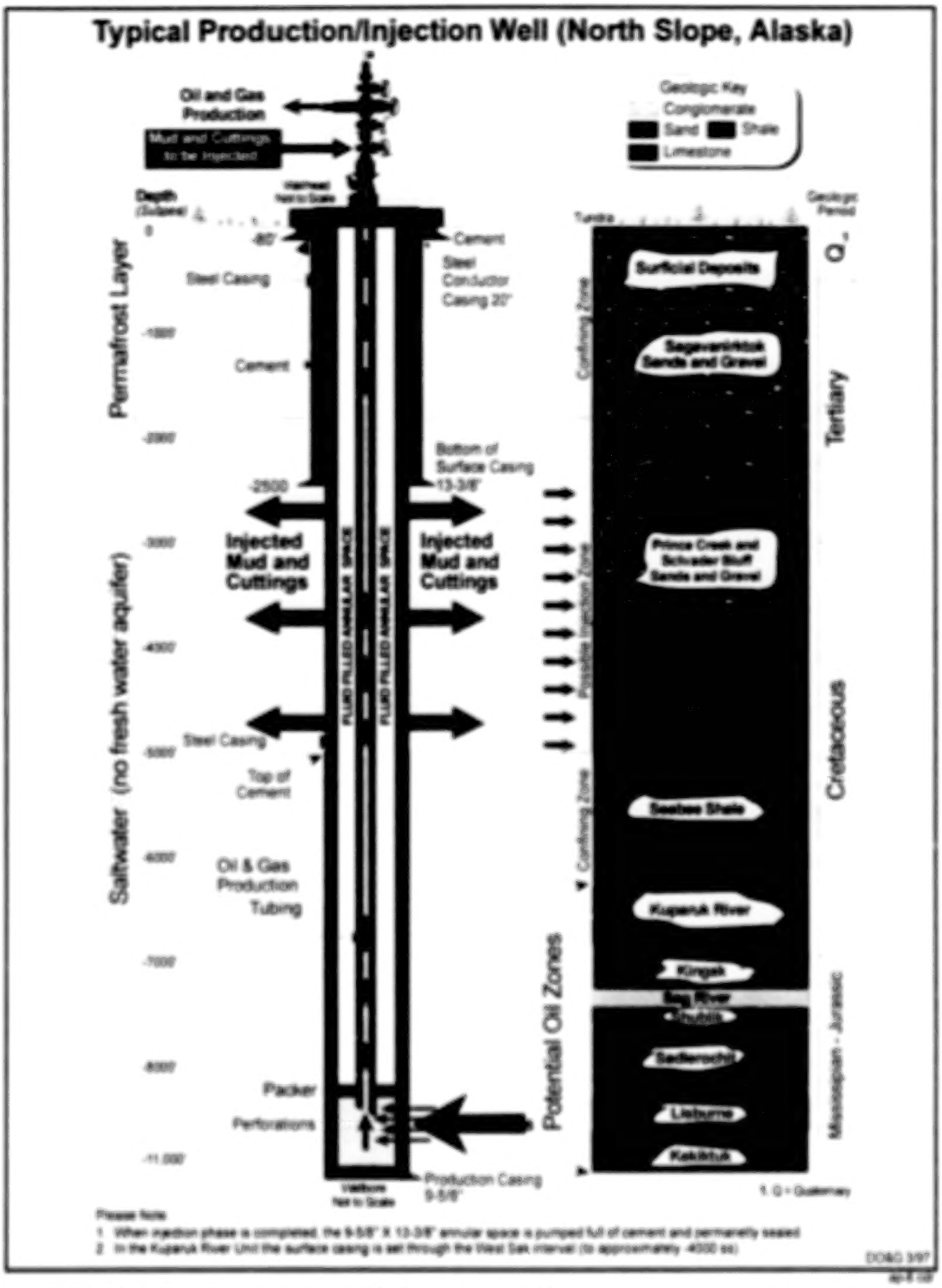
(b) Production Rates: Individual well-production rates vary greatly, depending on the characteristics of the reservoir, from a few hundred barrels per day to several thousand barrels per day. Generally, the highest production rates occur in the first 1 to 2 years of a well's life and thereafter declines progressively with time.

As well-production rate drops to near half of the peak rate, operations called "workovers" are conducted to improve well productivity. These operations are designed to correct a variety of potential well problems (e.g., corrosion, plugged screens) and problems in the reservoir itself (e.g., migration of fines, mineral precipitation). Workover operations typically occur at intervals of 3 to 5 years. More severe downhole problems could require reservoir stimulation by pressure fracturing or acidizing methods.

Current well workovers on the North Slope often call for redrilling laterally from existing wellbores to recover oil in unswept portions of the reservoirs. Coil-tubing rigs are normally used to drill sidetracks from existing wellbores. These rigs are smaller, more mobile, and less costly to operate than standard drilling rigs, and coiled-tubing-production strings are more flexible for special completion situations. Completing multiple laterals into a reservoir usually increases well-production rates.

Because production-well drilling and completion are spread over several years (2-5 years for a typical field [Table IV.A.1.b-1]), the production profile for the field is much broader than for any individual well. Initial production usually occurs when a certain proportion of the wells have been completed, and the production profile will then "ramp up" to peak production when most wells are online. Typical ramp-up periods vary from 2 to 5 years, with plateaus at peak rate lasting 3 to 8 years.

(c) Waterflooding: Waterflooding is a key production procedure that significantly can increase oil recovery. Injecting water into selected areas of the reservoir maintains subsurface pressure and promotes fluid flow to the production wells. To maintain reservoir pressure, the volume of oil withdrawn from the reservoir



Please Note:
1. When injection phase is completed, the 9-5/8" X 13-3/8" annular space is pumped full of cement and permanently sealed.
2. In the Kuparuk River Unit the surface casing is set through the West Sak interval (to approximately -4000 ss).

Figure IV.A.1.b-6. Subsurface Injection of Mud and Cuttings. After processing, muds and rock cuttings are injected into the annular space of producing wells. Formations receiving the materials are 2,500–5,000 feet below the surface. When the injection phase is completed, the annular space is permanently sealed by cement. (Figure courtesy of ADNR.)

273

must be replaced with an equivalent volume of another fluid. This requires large quantities of water. For example, a field with a daily production rate of 50,000 barrels (bbl) of oil would require approximately 2 million gal/day of water (1 bbl = 42 gal) for balanced waterflooding, with some volumetric allowances (less than [<]20%) for each fluid under subsurface conditions. This example waterflood program would require 767 million gal (2,352 acre-feet) each year.

To meet waterflood demands, a variety of local water sources are investigated. These potential sources could include surface water bodies (large rivers and deep lakes) as well as subsurface aquifers. Normally, there are restrictions to withdrawals from surface water sources that are vital to fish and waterfowl. Drilling water wells below the permafrost layer (up to 1,500-ft thick) and pumping water from subsurface aquifers is costly. All freshwater sources must be treated so that they are chemically compatible will the formation they are injected into.

Often, local water sources are inadequate to meet the demands of waterflood programs, so seawater is used. Seawater is reasonably compatible (similar chemically) to the brines present in most petroleum reservoirs, and seawater supplies are virtually unlimited. Waterflood systems include a seawater intake and treatment plant located on the coast and an insulated pipeline from the seawater plant to service wells in the field. Waterflood programs using seawater are initiated from the onset of production for most North Slope oilfields. As the oilfield is produced, the volumes of formation water recovered with oil (water cut) increases. In time (5-7 years), waterflood demands are met by produced formation water, and treated seawater output can be used for the next startup field.

New oilfields in the northeastern portion of the planning area are likely to receive seawater for waterflooding programs from existing facilities now serving fields in the Prudhoe/Kuparuk area. Seawater pipelines will be installed on vertical support member (VSM) pipeline supports that also hold sales-oil and service pipelines. For areas farther to the west, seawater intake and treatment plants are likely to be fabricated on barges and moved into temporary locations along the coast. Because the ability to incorporate waterflooding as a reservoir management strategy greatly improves recovery efficiency, the economics of fields discovered near the coastline could be improved. However, the value of increased oil recovery will be balanced against the increased costs of seawater-treatment facilities and temporary overland pipelines. With increasing distances inland, expensive heat generators and pump stations may be required to deliver treated seawater to remote fields in the severely cold winter temperatures of the North Slope. Small or very remote fields may not be able to justify the costs of startup waterflood programs and will rely entirely on later waterflooding using produced formation water.

(d) Abandonment: At some time in the lifecycle of all fields, the revenue from production is insufficient to justify the expenses of operation. The end of economic life always occurs before all of the potentially recoverable oil is extracted from the reservoir. Specific factors leading to the decision to abandon a field could differ for each field, but declining production rates and oil price usually are the two key factors.

Abandonment operations generally include removal of all equipment, plugging all wells, attempting to restore the site to its original condition, and final environmental studies. Overall, abandonment operations could take many years, as revegetation and environmental monitoring studies continue to document the long-term effects of operations at a particular site. A series of permitting and inspection activities are associated with abandonment procedures.

(6) Transportation:

(a) Regional Oil Transportation: A regional oil-transportation system for the North Slope oilfields was established in 1977 upon completion of the TAPS. Oil is transported some 800 mi south through a 48 in pipeline and 12 pump stations (7 are still active) to the ice-free port of Valdez, Alaska. From the storage and marine loading terminal at Valdez, oil is loaded on tankers and transported to U.S. and foreign markets.

The throughput capacity of the TAPS pipeline is a vital factor to North Slope development. The maximum daily throughput capacity of TAPS is slightly over 2.0 MMbbl per day (achieved in 1988). Currently, TAPS throughput is 1.35 MMbbl per day. The minimum throughput for a viable TAPS operation has been widely debated by government and industry. The common perception is that a minimum throughput between 200,000 and 500,000 bbl per day represents realistic mechanical and economic limits to operation. When this minimum throughput rate will be reached also is speculative, because it is difficult to accurately predict the size and timing of new oilfield development on the North Slope. However, based on the declining production trends of existing North Slope fields, and without changes to economic conditions or discovery of major new oil fields, the operational limits of TAPS could be reached within the next 20 years. Industry is well aware of this future problem, and aggressive efforts are under way by the North Slope producers to reverse the production decline trend by exploring for new fields and using innovative methods to develop marginal fields. Renewed industry interest in the NPR-A is an important part of strategies to maintain TAPS throughput within acceptable limits. For all NPR-A development scenarios, it is assumed that TAPS will continue to operate as the transportation artery for North Slope oil production.

(b) North Slope Pipelines: The central portion of the North Slope contains numerous oilfields connected by pipeline-gathering systems to the TAPS Pump Station No. 1. It is likely that new development projects in the NPR-A will use the main line between the KRU and Pump Station No. 1. The 24-in KRU pipeline has the capacity of approximately 350,000 bbl per day and is currently transporting 325,000 bbl per day. As the large fields (Kuparuk, Milne Point) feeding this pipeline decline, excess pipeline capacity could be used by new fields. The current KRU pipeline tariff is $0.21/bbl, far lower than new pipeline construct costs.

A new sales-oil pipeline from the Alpine field will connect to the KRU infrastructure at its westernmost facility (CPF-2). The new Alpine pipeline will use an innovative technique to cross the Colville River, which is 4,000 ft wide at the selected point. A horizontal directionally drilled (HDD) tunnel will establish a 36 in conduit approximately 100 ft below the river bed to hold the pipelines serving the field. Although the Alpine sales-oil pipeline (14 in diameter) is sized for Alpine production of 60,000 to 80,000 bbl per day, additional capacity could be gained by installing pump stations and using drag-reducing agents. ARCO claims that the Alpine pipeline capacity could be increased to as much as 200,000 bbl per day, easily accommodating another Alpine-size field.

The timing of future discoveries and development also could accommodate the use of Alpine's pipeline as a common carrier for future NPR-A oil production. Peak production at Alpine (60,000 bbl/day) will last only 3 to 5 years, with production rates declining to about half of peak rate (30,000 bbl/day) 15 years after startup. The discovery of new fields in the NPR-A is likely to be staggered (variable success), and periods of 8 to 10 years are expected between discovery and startup of production (Table IV.A.1.b-1). Considering the relatively long lead times for development after discovery and the relatively short periods of peak production, it is likely that the Alpine pipeline could be used as a main line for future NPR-A oil production. Modifications to the Alpine pipeline (pump stations) could provide additional flexibility for adding capacity to this pipeline system.

(c) Future NPR-A Pipelines: The actual locations of new pipelines constructed in the planning area depend on both the location and sequence of discoveries of commercial-sized oilfields. Fields developed early will establish the first pipeline corridors connecting NPR-A production to existing infrastructure. Fields discovered and developed later will attempt to use these existing pipelines if capacity is available. If large fields are discovered late in the exploration sequence, they may require their own sales-oil pipelines. It is possible that commercial-sized fields discovered by different companies will be shut-in (not produced) until an agreement is reached to share the costs of constructing a large main line from the NPR-A.

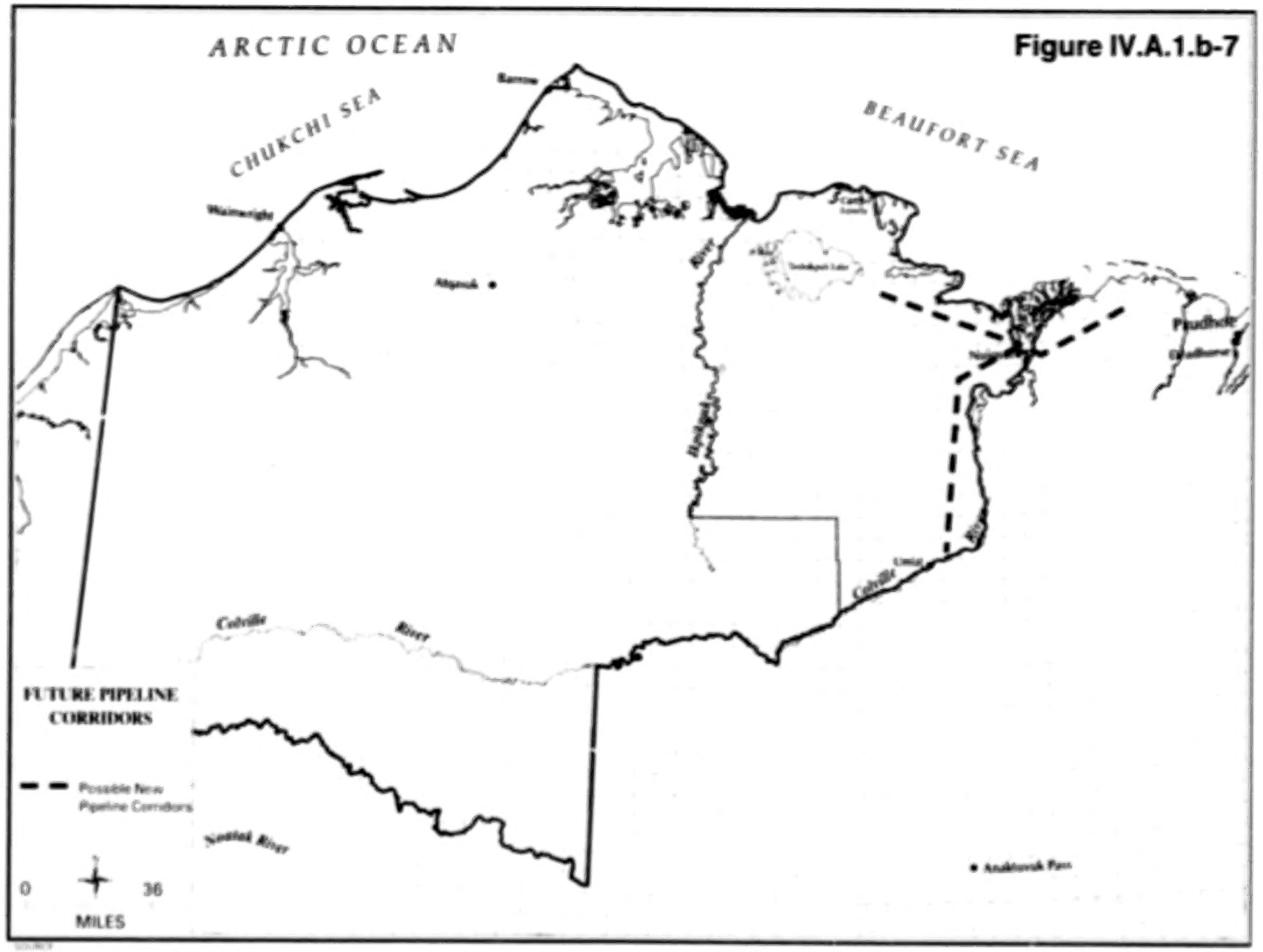
The diameters and lengths of new pipelines in the NPR-A are summarized in the following scenario section. The pipeline data are specific to resource-development levels for each leasing alternative. Generally, infield pipelines (flowlines) carry multiphase slurries (oil, gas, water) from wellhead manifolds to central processing plants. Return lines containing gas or water will carry these substances back to injection wells on production pads. Infield flowlines are relatively small in diameter (4-10 in). Somewhat larger sales-oil pipelines (12-16 in) will carry metered sales-quality oil from individual fields to a centrally located main line (16-20 in). This main pipeline would then connect several producing fields to the KRU pipeline (24 in) and then on to the TAPS (48 in).

Possible future pipeline corridors in the NPR-A are shown in Figure IV.A.1.b-7. These speculative main-line routes are based on several factors, including oil-resource potential, previous leasing, and previous discoveries. No implication regarding specific prospect location is intended. The actual location of undiscovered, commercial-sized fields and the timing of their discovery is impossible to predict. These pipeline corridors represent only one possible scenario. Site-specific discussions regarding future development are misleading.

(d) Pipeline Construction: Pipeline-construction techniques have evolved over decades of experience in the unique North Slope environment. The following assumptions cover the general practices in pipeline design and construction likely to be adopted for future NPR-A projects.

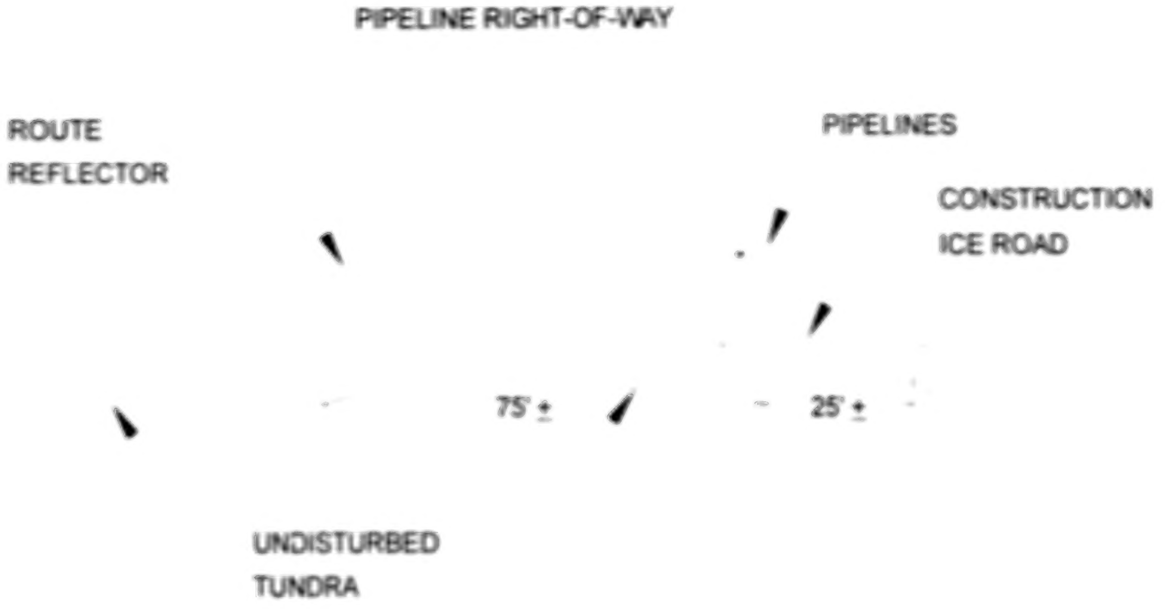
1. Pipeline crossings of large rivers, such as the Colville River, will use the HDD techniques demonstrated by the Alpine project. Permanent bridges across the Colville River are not feasible for both practical and economic reasons.
2. Relatively wide, shallow rivers will be crossed by trenching and burial of insulated pipelines in the river bed. These buried pipelines would be installed in winter at locations selected to minimize disturbance to overwintering fish habitat.
3. Narrow streams will be crossed by elevated pipelines on suspension spans.
4. Pipeline alignments will be routed to avoid crossing lakes.

Figure IV.A.1.b-7



BEST COPY AVAILABLE

BLANK PAGE


PIPELINE RIGHT-OF-WAY

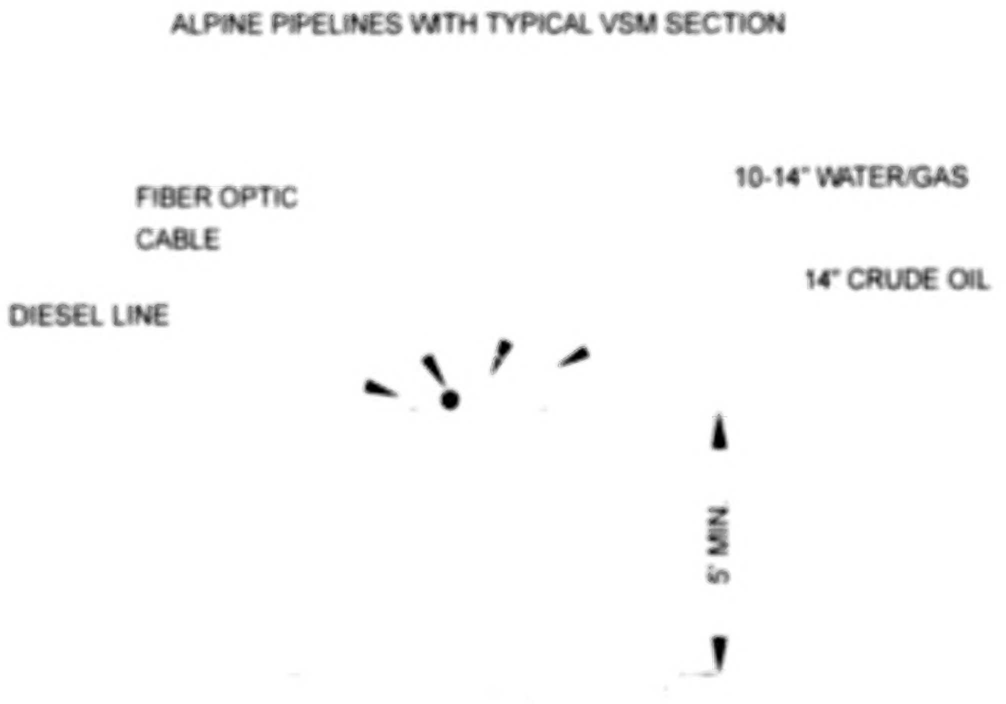

ALPINE PIPELINES WITH TYPICAL VSM SECTION

Figure IV.A.1.b-8. Typical Pipeline Construction. Future pipelines in NPR-A are likely to be elevated on Vertical Support Members (VSM). A minimum height of 5 ft is maintained to minimize wildlife disturbance. Pipelines are installed during winter using ice roads, and there will be no permanent gravel road paralleling pipeline corridors. (Figure taken from Alpine Project description, courtesy of ARCO Alaska, Inc.)

5. Pump stations could be required along the new mainline route, depending on distances, pipeline diameters, and production rates.

Pipeline routes are generally laid out in straight-line segments (alignments) and are installed above ground on VSM's (Fig. IV.A.1.b-8). This installation method is preferred over buried pipelines, because it is faster to construct, poses less disruption to the land during installation, is easier to monitor and repair, and is more flexible in terms of later modifications. The VSM's generally are spaced 55 to 70 ft apart and are installed with minimum heights of 5 ft above the ground to minimize disturbance to caribou herd movements. Pipeline clearance generally is higher (up to 20 ft) over topographic lows (stream valleys), because engineering calls for a nearly level pipeline route. Small, shallow lakes may have elevated VSM's across them; whereas large or deep lakes will have pipeline VSM's routed around their shorelines with some setback.

An important assumption for NPR-A development is that new sales-oil pipelines will not have parallel gravel roads. This assumption is based on both economic and environmental reasons. Gravel is a scarce commodity in the NPR-A, and long gravel roads would add heavy cost burdens to development projects. Environmental concerns regarding elevated roads as barriers to animal movement or surface waterflow also are eliminated by the "roadless development" scenario. From a safety standpoint, roads would allow more direct monitoring of pipelines and more rapid response time should repairs be necessary. However, a variety of remote-inspection techniques have been refined by years of operations on the North Slope, including pressure-metering devices, routine internal (pig) inspections, and visual inspections by aircraft and by vehicles along winter ice roads parallel to the line. Mechanical shutoff values are being replaced by vertical expansion loops to provide a more failsafe method of controlling pipeline pressures and leaks.

(7) Development Scenarios:

(a) Resource Potential and Related Activities: A variety of activities are associated with petroleum development, beginning with the leasing of tracts and ending perhaps decades later with abandonment of depleted fields. A general timeframe for exploration, development, and production activities is given as Table IV.A.1.b-1. For purposes of environmental analysis, the level of activities is assumed to be directly related to the resource potential of an area. However, industry's interest in developing the resources ultimately controls future petroleum-related activity. Industry's commitment to an area is driven largely by profit motives, and each company may view the geologic or economic opportunities of an area differently. Some companies pursue high-risk, high-reward ventures, while others prefer safer investments. Major oil companies may take a more global perspective, while smaller independents tend to concentrate on domestic projects. Perceptions of economic potential can change quickly with new data or economic conditions.

Two sets of development scenarios are presented here. The first set includes activities estimated to occur as a result of the next lease sale in the NPR-A. This sale, tentatively scheduled for late 1998, is the first sale in a possible series of future lease sales offering various parts of the NPR-A. Although it is referred to as the "first sale" in this EIS, it actually is the fifth NPR-A lease offering. All tracts leased in previous sales (1982-1984) have been relinquished. The second set of development scenarios includes the activities associated with developing and producing the total resource potential under the various lease-sale alternatives. This is referred to as the "multiple-sale" scenario. If multiple lease sales are held and industry is allowed to thoroughly explore the area, it is assumed that all of the economic resources eventually will be discovered and developed. As indicated by the activity projections, a large fraction (at least half) of the resource production is expected to occur as a result of the first sale in the series, with progressively lower fractions occurring from each subsequent sale. Petroleum-related activities, are presumed to follow similar trends.

The resource estimates for the "first-sale" scenarios have been scaled down from the total economically recoverable resources modeled in the planning area. This reduction is made because despite their best efforts, industry is not likely to lease and discover all of the commercial oilfields as the result of a single lease sale. A variety of factors were considered in making the subjective estimates for the "amount assumed to be leased, developed, and produced" as a result of the next sale in the NPR-A. These considerations included (among others): previous exploration activities in the NPR-A, new geologic data or play concepts, current technology capabilities in detecting prospects using seismic data, and proximity to existing infrastructure. Of paramount importance is the availability of high-potential areas to leasing and possible future development. If available for leasing, high-potential areas provide the opportunity for commercial success and are an incentive for industry to participate in renewed exploration of the NPR-A.

The following scenarios attempt to portray a reasonable sequence of activities that could occur as a result of the next lease sale in the planning area. Other scenarios are possible and equally likely. No attempt is made to provide a full spectrum of "what-if" analyses. Rather, a simple generalized scenario, based on current practices on the North Slope, is adopted.

Table IV.A.1.b-2 Exploration-Only Schedule for the First Sale

At prices below $18 per barrel, some exploration will occur, but production would be uneconomic.

	Exploration Wells	Delineation Wells	Exploration/ Delineation Rigs	Production Pads	Production and Service Wells	Production Rigs	Staging Areas	Oil Production	Pipeline Miles
1998	Lease Sale								
1999									
2000	1								
2001									
2002									
2003	1	1	1						
2004									
2005									
2006	1		1						
Total	3	1	1[1]	0	0	0	0[2]	0[3]	0

Notes: [1] Maximum exploration/delineation or production drilling rigs operating in any single year. [2] Assumes exploration operations utilize existing facilities. [3] Discovered oilfields are smaller than threshold for stand-alone economic viability (approx. 140 MMbbl).

Table IV.A.1.b-3 Development Schedule for the First Sale

At prices of $18 per barrel, we estimate that 250 million barrels of oil could be discovered and produced; at prices of $30 per barrel, 1,100 million barrels could be discovered and produced.

	Exploration Wells		Delineation Wells		Exploration/ Delineation Rigs		Production Pads		Production and Service Wells		Production Rigs		Staging Bases		Oil Production		Pipeline Miles	
MMbbl	250	1100	250	1100	250	1100	250	1100	250	1100	250	1100	CL	UM	250	1100	250	1100
1998	Lease Sale																	
1999																		
2000	1	1			1	1												
2001	1	2	1	1	1	2												
2002		1	2	3	1	3												
2003	1	2	2	4	2	4							0.1					
2004		2		1		2							0.1					
2005	1	2	1	2	1	3												
2006		2		3		4	2	3						0.1			50	50
2007	1	2		3		4			24	39	2	3	0.2	0.1			30	30
2008		1		4		3			30	45	2	3	0.2	0.1	16	16		10
2009				2		1		2	21	36	2	3	0.1		21	30		
2010										24		2	0.2		21	36		25
2011								2		24		2	0.1	0.1	21	48		
2012										36		4		0.1	21	56		15
2013										24		2		0.2	21	68		
2014								2		12		2		0.2	19	72		45
2015										30		2		0.1	17	68		30
2016										30		2			15	81		
2017										30		2			13	81		
2018															11	73		
2019															10	67		
2020															9	61		
2021															8	56		
2022															7	49		
2023															6	43		
2024															5	37		
2025															4	33		
2026															3	28		
2027															2	25		
2028																20		
2029																15		
2030																11		
2031																9		
2032																7		
2033																6		
2034																4		
2035																3		
Total	5	15	6	23	2	4	2	9	75	330	2	4	2.0		250	1100	80	205

Notes: (1) Exploration well totals include both dry wells and discoveries. (2) Rig totals are maximum number operating in any single year. (3) Production to service well ratio is 2:1. (4) Staging bases are at Camp Lonely (CL) and Umiat (UM) for the high resource case only. (5) Pipeline miles do not include in-field flowlines, only sales oil gathering lines to the Kuparuk River Unit (KRU).

The ***exploration-only scenario*** (Table IV.A.1.b-2) is expected after the next lease sale if oil prices drop and remain for long periods of time below $18 per barrel or if exploration efforts yield subeconomic quantities of oil. The discovery of gas fields also is considered as an "exploration-only" case, because these resources are very unlikely to be developed in the foreseeable future. With low oil prices, it will be difficult to realize profitability in this remote, high-cost operating area, so industry will lease and explore at a very modest pace. Winter seismic surveys would be infrequent, perhaps one survey crew operating in alternate winter seasons. Exploration drilling could occur selectively on very attractive (large) prospects located near existing infrastructure. If limited drilling and seismic-survey work results in discoveries, it is likely that the fields will be shut-in awaiting higher oil prices. We assume that no oil- development activities will occur because discoveries (if any) would not be profitable to produce.

The ***oil-development scenario*** (Table IV.A.1.b-3) assumes that oil prices will range between $18 and $30 (in constant dollars) in the foreseeable future. Development activities and corresponding resource production are given as ranges to acknowledge the uncertainties in estimating future development of undiscovered petroleum resources.

Table IV.A.1.b-3 represents a maximum level of activities from next lease sale if the entire planning area is available for leasing and possible development. The low end of the range is defined by oil-production-related activities for 250 MMbbl, and assumes that at least one commercial field will be discovered and produced. The upper end of the range is represented by oil-production-related activities for 1,100 MMbbl, where as many as five commercial fields could be discovered in the planning area. For purposes of analysis, we assumed that these five fields have varying sizes of 150 to 300 MMbbl in recoverable reserves. It also is possible that fewer, but somewhat larger fields, will be discovered and developed. The above resource estimate assumes that the entire planning area is available for leasing, and that no regulatory restrictions are adopted that would adversely affect leasing interest or the economic viability of discoveries.

Leasing Alternatives (Tables IV.A.1.b-4 and IV.A.1.b-5). Five leasing alternatives have been proposed for the next lease sale, each with varying degrees of restrictions (areas unavailable for leasing and lease stipulations). Because of area restrictions, exploration opportunities are decreased and progressively lower levels of activities and oil production are expected. If areas of high geologic potential are not available for leasing, industry participation in leasing and exploration is likely to be reduced. Restrictions on activities could affect project viability, leading in some cases to the abandonment of marginal fields.

To generate the activity schedules (Tables IV.A.1.b-2 and IV.A.1.b-3), numerous assumptions are made:

- The next NPR-A lease sale will be held in 1998.
- Industry will be aggressive in their leasing and exploration efforts, leading to frequent discoveries of new commercial-sized oilfields.
- Several industry groups will independently explore and develop new fields in the NPR-A.
- There will be no long-lasting legal or regulatory delays to exploration or development.
- Restrictions on development (lease stipulations) will not adversely affect the viability of potentially commercial discoveries.
- Activities will not be constrained by the availability of drilling rigs or other materials necessary for development.
- Future oil production from the NPR-A will use existing North Slope infrastructure, including the TAPS, to transport oil to outside markets.
- Activities are shown on an annual basis, but many operations are seasonal. For example, exploration and construction activities occur mainly in winter, whereas production-well drilling occurs year-round.
- Commercial fields will be developed on a stand-alone basis; that is, they will have individual production pads, processing facilities, and a sales-oil pipeline.
- The first field developed will support the cost of a main pipeline to KRU, whereas fields discovered subsequently will attempt to use existing pipelines, if capacity is available.
- Individual production pads in a field will recover an average of 150 MMbbl of oil, with oil wells ultimately producing 5 MMbbl each.
- Typical production pads will hold 30 producer wells and 15 service wells for a total of 45 wells. Producer wells will be drilled first, followed by service wells.
- Production wells average 10,000 ft (drilled depth), and 12 to 18 wells can be completed by one rig each year. We assume that one drilling rig will operate on each pad.
- Two new staging areas (Camp Lonely and Umiat) will be developed for the high-resource case (1,100 MMbbl). For the low-resource case (250 MMbbl), exploration and development will be staged from the KRU.

(b) Changes in Activity Levels for Leasing Alternatives: Several leasing alternatives are under consideration, each providing different levels of protection for environmental and cultural values. A direct relationship between the levels of protection and the reductions in petroleum development is very probable. Alternative E (the entire area is available for leasing, Table IV.A.1.b-3) is used as a basis for comparison, and activities

Table IV.A.1.b-4 Resource Estimates for the First Sale in Each Alternative

At oil prices ranging from $18 to $30 per barrel

	Alternative	$18 oil price (MMbbl)	$30 oil price (MMbbl)	Number of fields
A	No Leasing	0	0	0
B	Deletions	65 *	350	0 to 1
C	Deletions	75 *	410	1 to 2
D	Deletions	185	825	1 to 4
E	Open	250	1,100	1 to 5

Notes Resources are economic oil volumes expected to be leased, discovered, developed, and produced as a result of the next NPR-A lease sale in the planning area. * Resources of this size are not economically viable as stand-alone fields. Fields discovered under Alternative B are too far from Alpine to share production infrastructure and are, therefore, noncommercial. Fields discovered under Alternative C could be located close enough to Alpine to share infrastructure and could be commercial under these circumstances.

Table IV.A.1.b-5 Levels of Activities for the First Sale under Each Alternative

At prices ranging from $18 to $30 per barrel

	Exploration Wells		Delineation Wells		Exploration/ Delineation Rigs		Production Pads		Production and Service Wells		Production Rigs		Staging Bases		Peak Oil Production (MMbbl/yr)		Pipeline Miles	
A	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0	0	0	0
B	1	4	0	6	1	1	0	2	0	83	0	2	0.0	0.0	0	35	0	75
C	2	6	2	9	1	2	1	2	23	122	1	2	0.0	0.0	8	41	10	90
D	4	11	5	17	2	4	1	6	56	248	1	4	0.0	1.0	16	61	80	105
E	5	15	6	23	2	4	2	9	75	330	2	5	0.0	2.0	21	81	80	205

Notes (1) Exploration well totals include both dry wells and discoveries. (2) Rig totals are maximum number operating in any single year. (3) Production-to-service well ratio is 2:1. (4) Staging bases are at Camp Lonely (CL) and Umiat (UM) for the high resource case only (1,100 MMbbl). (5) Pipeline miles do not include in-field flowlines, only sales-oil gathering lines and main lines.

Table IV.A.1.b-6 Resource Estimates for Multiple Sales Under the Alternatives

At oil prices ranging from $18 to $30 per barrel

	Alternative	$18 oil price (MMbbl)	$30 oil price (MMbbl)	Number of fields
A	No Leasing	0	0	0
B	Deletions	90 *	500	0 to 2
C	Deletions	110 *	580	1 to 3
D	Deletions	370	1,680	2 to 7
E	Open	500	2,200	2 to 10

Notes (1) Resources are economic oil volumes estimated to be available in respective alternative areas within the planning area. (2) Oil volumes are rounded to the nearest 10% value. * Resources of this size are not economically viable as stand-alone fields. Fields discovered under Alternative B are too far from Alpine to share production infrastructure and are, therefore, noncommercial. Fields discovered under Alternative C could be located close enough to Alpine to share infrastructure and could be commercial under these circumstances.

Table IV.A.1.b-7 Levels of Activities for Multiple Sales Under the Alternatives

At prices ranging from $18 to $30 per barrel

	Exploration Wells		Delineation Wells		Exploration/ Delineation Rigs		Production Pads		Production and Service Wells		Production Rigs		Staging Bases		Peak Oil Production (MMbbl/yr)		Pipeline Miles	
A	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0	0	0	0
B	4	14	0	12	1	2	0	4	0	190	0	3	0.0	0.0	0	42	0	90
C	6	18	2	15	2	3	1	5	33	174	1	4	0.0	1.0	10	49	10	105
D	12	44	12	36	2	4	3	12	111	495	3	8	0.0	2.0	19	73	95	150
E	15	60	12	49	3	5	4	16	150	660	4	10	1.0	3.0	25	97	95	280

Notes (1) Exploration well totals include both dry wells and discoveries. (2) Rig totals are maximum number operating in any single year. (3) Production-to-service well ratio is 2:1. (4) Staging bases are at Camp Lonely, Umiat, and Inigok. (5) Pipeline miles do not include in-field flowlines, only sales-oil gathering lines and main lines.

associated with the other alternatives are reduced from this level

Alternative A is the no-action alternative. It reflects current BLM management of the NPR-A, where no oil and gas lease sales are scheduled. There would be no industrial development, but there is likely to be a continuation of exploration activities (aerial surveys and occasional field parties in summer and seismic surveys in winter).

Alternative B provides for maximum protection of surface resources. No oil and gas leasing or development would occur in the numerous LUEA's except for the Kuukpik Corporation Entitlement LUEA, in which leasing is deferred until the corporation's entitlement is satisfied. River corridors could be protected for future designation as special areas or wild and scenic rivers (upper Colville and Ikpikpuk rivers). Approximately half of the planning area would be available for leasing and development, but only one-quarter of the high-oil-potential area along the northern coastal plain would be offered for leasing.

Alternative C focuses on maximum protection of certain wildlife resources (waterfowl and caribou) by withholding large areas of the valuable habitat surrounding Teshekpuk Lake from leasing and development. The remainder of the planning area (approximately 75%) would be available for leasing and possible development, but less than half of the high-oil-potential area would be offered.

Alternative D focuses on maximum protection of certain wildlife resources (waterfowl and caribou) by withholding smaller key habitat areas north of Teshekpuk Lake from leasing and applying management practices, in the form of lease stipulations, to mitigate potential impacts of future development in surrounding areas. A complete listing of the stipulations and discussion of the mitigation effects is given in Section II. Under Alternative D, nearly 90 percent of the planning area would be available for leasing, including most of the high-oil-potential area.

Alternative E is designed to allow oil and gas leasing and development of all lands administered by BLM in the planning area. While no areas are unavailable to leasing, future petroleum-related activities would be conducted under the comprehensive regulations (Sec. II). Environmental protection is achieved by establishing management practices and design features consistent with technically feasible petroleum development. The economic impact of regulatory restrictions could range from minimal to severe, depending largely on the location of future discoveries.

Table IV.A.1.b-4 summarizes the estimated petroleum production associated with the first sale under each leasing alternative. Resource estimates were determined by considering several factors, including: industry interest, location of identified prospects, regional stratigraphic trends, and relevant well data. Resource reductions were made proportionally on a play-by-play basis and then summed to determine the resources available for leasing under each alternative. Because the northern portion of the planning area is estimated to contain over 90 percent of the oil potential, significant reductions in production and related activities are expected if these lands are unavailable to leasing and development.

The levels of activities for the first sale under each leasing alternative is provided in Table IV.A.1.b-5. The activities were scaled downward proportionately to the changes in resource estimates. There is at least one stand-alone, economically viable field in all alternatives except for Alternative A (no action). Alternative C was modified with respect to the stand-alone field assumption. At the $18-per-barrel price level, a 75 MMbbl field would be commercial only if it was close enough to a larger field (probably Alpine) to use its processing facility and sales-oil pipeline. However, a similar assumption applied to Alternative B would not result in a viable field in the $18-per-barrel case, because tracts offered for leasing would be too far from existing infrastructure (Alpine). Depending on its location, a field twice this size (150 MMbbl) also could require infrastructure sharing to be viable under lower price conditions.

The development cycle begins with leasing, followed by exploration drilling. Future petroleum-related activity is ultimately controlled by industry's perception of the opportunities for profitable operations. Although we assumed that the regulatory stipulations adopted under Alternatives D and E would not affect economic viability, they could, in fact, cause significant reductions in oil production and negative economic impacts. These impacts could include lower leasing activity (fewer tracts), reduced exploration (fewer prospects tested), delayed production startups, or abandonment of marginal discoveries (no development).

An accurate evaluation of the economic affect of lease stipulations is not possible, because the effects depend largely on the location of oil prospects. On one extreme, if a prospect is located in an area unavailable for leasing, it will not be leased or discovered. On the another extreme, if the area is available for leasing and compromises can be reached to mitigate impacts, then commercial development is possible. The effects of withholding areas from leasing and regulations on future petroleum activities in the NPR-A could range from minimal to severe depending entirely on field location.

(c) **Multiple-Sale Scenario**: The principle assumption for the multiple-sale scenario is that the total economic resource potential of a particular area could be discovered and produced given the opportunity for sufficient exploration by industry. Considerable effort could be required to discover all of the resources in a frontier province. Attanasi and Bird (1995) estimated the number of wildcat wells needed to discover the total undiscovered oil resources in northern Alaska as part of the 1995 National Resource Assessment. For the central coastal plain subarea (containing the northern part of the planning area), they estimate that between 40 and 180 wildcat wells would be required to discover all of the resources at prices ranging from $21 to $30 per barrel. Using an areal approximation, the planning area covers 60 percent of this subarea, so a well-number estimate (based on their methodology) would be 24 to 108 wells. However, more often, only the "best" prospects available are leased and tested by drilling before exploration moves off into different areas. Many areas are underexplored because of changing economic conditions and corporate strategies which could be unrelated to perceptions of undiscovered resource potential. For example, only one industry test well (ARCO, Brontosaurus) was drilled in the NPR-A as a result of three lease sales held in the early 1980's.

For purposes of analysis, the activities associated with multiple-sale scenarios can be estimated by simply scaling the numbers up to the full undiscovered economic potential available under each alternative. Several key assumptions are necessary to qualify this approach:

1. Multiple lease sales will be held.
2. Industry will aggressively lease and explore the tracts offered. This could require large numbers of exploration wells (see above) and seismic surveys.
3. Economic conditions (particularly oil price) would remain favorable to development in northern Alaska.
4. New geologic information will not significantly change the present assessment of resource potential. High-potential plays will not be condemned by future drilling and new high-potential plays will not be discovered.
5. Learning curves will improve efficiencies over time for both prospect identification and engineering technology. Learning curves lead to higher commercial success rates.
6. Future petroleum production will use existing North Slope infrastructure, most importantly the TAPS pipeline.

The timeframes for development under the multiple-sale scenarios are not included, because a future lease sale schedule has not been established. However, it is safe to assume that exploration activities as a result of multiple future sales will stretch considerably beyond the schedule for a single lease sale (Table IV.A.1.b-3). It is not reasonable to assume that the schedule generated for the next sale in the NPR-A will be replicated by subsequent sales. Historically, leasing and exploration interest tend to drop off during a series of lease offerings of the same area. Industry needs time to thoroughly evaluate existing leases before additional tracts are leased. For complete evaluation of petroleum resources, exploration activities could occur over decades.

With these conditions clearly in mind, the estimates for alternatives under the multiple-sale scenario are given in Tables IV.A.1.b-6 (petroleum resources) and IV.A.1.b-7 (petroleum activities).

c. Seismic Operations: Seismic operations will occur under all the alternatives, but the number of surveys and to some extent the type of survey will differ. Moreover, given a specific alternative, the number of seismic operations, the area they cover, and the layout of the survey grid is likely to be different from one year to the next. The following discussion recognizes this while giving some general assumptions on typical activities for the purpose of impact analysis. This information supplements the seismic discussion in Section IV.A.1.b(1).

In all of the alternatives, for both the single-sale and multiple-sale scenarios, 2-D seismic would be collected for regional reconnaissance purposes to identify potential prospects for leasing. Three-D seismic sometimes would be used for regional reconnaissance and also would be used on leased tracts to further delineate a prospect for exploration or appraisal drilling. Under all alternatives, nearly all seismic would take place in the area identified as having high oil and gas potential. For purposes of analysis, we estimate that the number of 3-D prospect delineation surveys is approximately equal to the number of commercial fields listed in Table IV.A.1.b-4.

Alternative A: Under Alternative A, it is assumed that one 2-D seismic operation will occur in alternate winter seasons in the planning area. No 3-D seismic is anticipated, because no leasing or development will occur.

Alternative B: Under Alternative B, it is assumed that one 2-D seismic survey will occur each winter and up to two 3-D operations will occur in alternate years. All 3-D seismic would occur within about 5 years of holding the first lease sale. Two-D seismic would continue annually for perhaps 10 years or so, after which it would occur in alternate winters.

Alternative C: Under Alternative C, it is assumed that one 2-D seismic survey will occur each winter and one to three 3-D operations will occur in alternate years. All 3-D seismic would occur within about 10 years of holding the first lease sale. Two-D seismic would continue annually for perhaps 15 years or so, after which it would occur in alternate winters.

Alternative D: Under Alternative D, it is assumed that one 2-D seismic survey will occur each winter with additional 3-D surveys occurring in alternate years. A total of two to seven 3-D seismic surveys would occur within about 15 years of holding the first lease sale. Two-D seismic could continue for perhaps 20 years or so, with the frequency decreasing to approximately every other winter in the second decade after the leasing is initiated.

Alternative E: Under Alternative E, it is assumed that one 2-D seismic survey will occur each winter with 3-D surveys occurring in alternate years. A total of 2 10, 3-D seismic surveys would occur within about 20 years of holding the first lease sale. Two-D seismic could continue for perhaps 25 years or so, with the frequency decreasing to approximately every other winter in the second decade after the leasing is initiated.

While the winter operating period could be as long as 5.5 months (early December-mid-May), typical seismic operations for an individual survey lasts about 100 days.

Cat trains for both kinds of seismic operations would likely originate from the Kuparuk oil field. Each cat train would consist of survey vehicles as well as support camp modular units. A train would consist of the approximately 10 (2-D) to 15 (3-D) vehicles that would run the seismic testing (see discussion below) and one or more fuel trucks and strings of trailers comprising the camp modular units pulled by bulldozers. A train typically would include two or three strings of trailers. Each would be pulled by a single bulldozer and each string would have 4 to 8 trailers. These bulldozers and modular units generally exert greater ground pressure than do the vehicles that run the seismic lines.

Once in the area of operation, camps typically are moved every few days to once a week. The fuel truck or trucks will make runs back to Kuparuk or other fuel-supply depot through the course of the seismic operation. These fuel runs may occur daily or every few days, depending on a variety of factors, including the size of the operation and weather conditions.

A typical 2-D operation will cover about 250 line-miles. The survey lines are in the form of a grid, with typical line spacings of 3 by 10 mi. Each line of 2-D seismic is run by about 10 vehicles. The vehicles run parallel to each other through an area about 200 ft wide. The exterior dimensions of each survey area is variable, but the example survey described above could cover a total of about 600 mi^2.

A typical 3-D seismic operation will collect 150 mi^2 of data in a single winter season and typically would involve about 15 vehicles. Each line mile consists of a pair of linear areas, each about 100 ft wide, through which the vehicles drive. The grid patterns for 3-D seismic surveys are considerably closer-spaced, with a typical line spacing of 500 ft by 2,000 ft. Although the exterior dimensions of 3-D survey grids is variable, a typical 10- by 15-mi survey area could contain about 1,875 line-miles of data. The techniques of setting up geophone arrays and shot points is very different (and far more efficient) than 2-D survey methods.

2. Oil Spills: The oil-spill analysis uses historical oil-spill databases and statistical methods to derive statistical information about Alaska North Slope and TAPS crude- and refined-oil spills. This statistical information includes estimates of how often a spill occurs for every billion barrels of oil produced (oil-spill rates), the mean (average) number of oil spills, and the mean and median size of oil spills from platforms, pipelines, and flowlines combined. The statistical information is then used to estimate the number, size and distribution of spills that may occur from reasonable and foreseeable development within the planning area. The oil-spill analysis considers the entire production life of the planning area and assumes: (1) commercial quantities of hydrocarbons are present in the planning area, and (2) these hydrocarbons will be developed and produced at the estimated resource levels. Uncertainties exist, such as (1) the estimates required for the assumed resource levels, (2) the actual size of a crude- or refined-oil spill, (3) the approximate location of oil assumed to be produced, or (4) whether production would occur at all. If no hydrocarbons exist, there is no risk of a crude-oil spill occurring in the planning area.

The history of crude- and refined-oil spills reported to the State of Alaska, Department of Environmental Conservation (ADEC) and the Joint Pipeline Office (JPO) is investigated to determine crude- and refined-oil spill rates and patterns from Alaska North Slope oil and gas exploration and development activities and the TAPS pipeline. Refined oil includes aviation fuel, diesel fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. The Alaska North Slope oil-spill analysis includes onshore oil and gas exploration and development spills from the Point Thompson Unit, Badami Unit, Kuparuk River Unit, Milne Point Unit, Prudhoe Bay West Operating Area, Prudhoe Bay East Operating Area, and Duck Island Unit. The TAPS pipeline oil-spill analysis includes spills from Pump Stations 1 through 12 and the 3 mi corridor associated with it from Prudhoe Bay to Valdez, but not the Valdez Marine Terminal. The TAPS tanker-oil-spill rates are not investigated here. The TAPS tanker-oil-spill rates are from

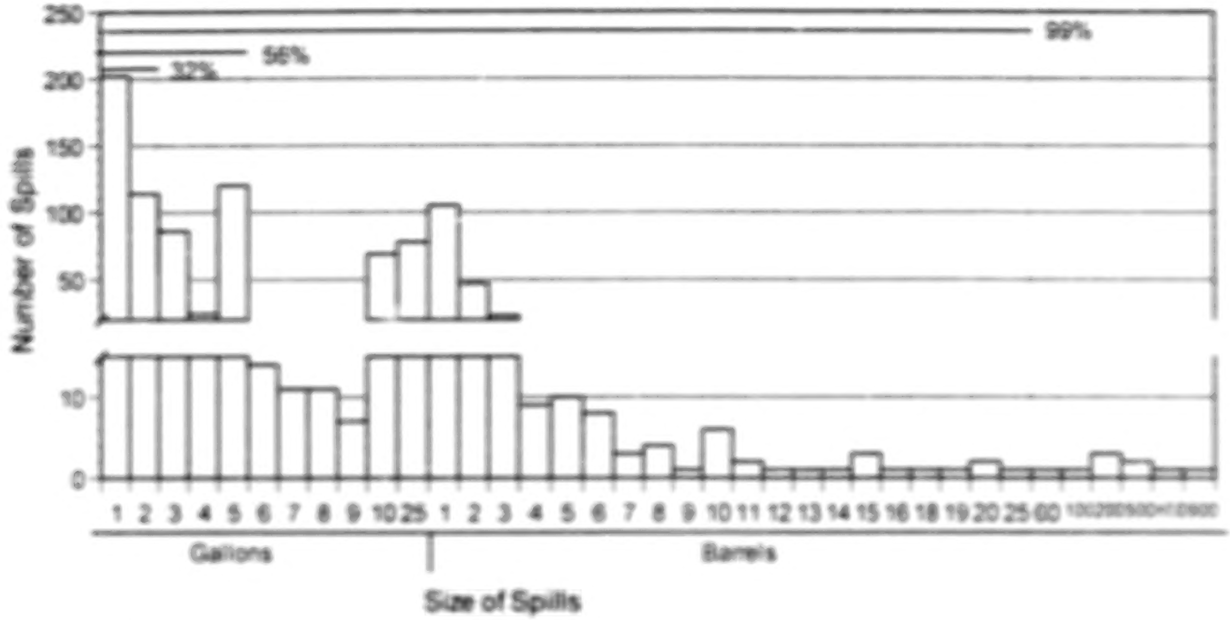


Figure IV.A.2. Alaska North Slope Crude Oil Spill Size Distribution and the Percent of Spills ≤2 Gallons, 5 Gallons, and 25 Barrels for the Period 1989-1996

Anderson and LaBelle (1994) and include all TAPS tanker routes.

The Alaska North Slope oil-spill database is from ADEC. Oil-spill information is provided to ADEC by private industry according to the State of Alaska Regulations 18 AAC 75. The totals are based on initial spill reports and may not contain updated information. The ADEC database integrity is most reliable for the period 1989 to 1996 due to increased scrutiny after the *Exxon Valdez* oil spill (Volt, 1997, pers. comm.). For this analysis, the ADEC database is spot checked against spill records from ARCO Alaska, Inc. and British Petroleum, Inc. All spills greater than or equal to [≥]1 gallon are included in the data set. The time period January 1989 to December 1996 is used in the Alaska North Slope oil-spill analysis for the Northeast NPR-A Planning Area IAP/EIS. For consistency, the same time period, January 1989 to December 1996, is used for the TAPS pipeline oil-spill analysis. The TAPS pipeline spill data are derived from both the ADEC and the JPO data sets. The amount of Alaska North Slope oil produced is derived from the TAPS throughput (Alyeska Pipeline Service Co., 1997; Shatick, 1997, pers. comm.).

A quantitative oil-spill analysis is performed, where the original database base structure provides for rigorous statistical analysis. Alaska North Slope oil-spill rates are estimated without regard to differentiating operation processes. The ADEC database base structure does not facilitate quantitative analysis of Alaska North Slope oil-spill rates separately for platforms, pipelines, or flowlines. Where quantitative oil-spill analysis is not possible, the patterns of oil spills are discussed qualitatively based on information from the ADEC database.

a. Estimated Planning Area Crude-Oil Spills: The three types of crude-oil spills analyzed with oilfield exploration, development, and production in the NPR-A are (1) accidental crude-oil spills from facilities, platforms, pipelines, and flowlines; (2) blowouts of crude oil; and (3) TAPS pipeline and tanker spills.

(1) Accidental Crude-Oil Spills: The analysis of Alaska North Slope crude oil spills is performed collectively for all facilities, pipelines, and flowlines. Figure IV.A.2 shows the size distribution of crude-oil spills from January 1989 to December 1996 on the Alaska North Slope. The pattern of crude-oil spills on the Alaska North Slope is one of numerous small spills. Thirty-two percent of crude oil spills that occurred between 1989 to 1996 were less than or equal to [≤]2 gal. Fifty-six percent were ≤5 gal. Ninety-nine percent of the crude-oil spills were <25 bbl. During that time period, no crude-oil spills >1,000 bbl occurred. The database base spill sizes range from <1 gal to 925 bbl. Only crude-oil spills >1 gal are used in the analysis. The average crude-oil-spill size on the Alaska North Slope is 3.8 bbl, and the median spill size is 7 gal. For purposes of analysis, this EIS assumes an average crude-oil-spill size of 4 bbl.

Table IV.A.2-1 shows the estimated crude-oil-spill rate for the Alaska North Slope is 199 spills per billion barrels produced. Table IV.A.2-2a shows the estimated occurrence of crude-oil spills for the first sale for Alternatives A through E. Table IV.A.2-2b shows the estimated occurrence of crude-oil spills over the life of the

Table IV.A.2-1 Estimated Alaska North Slope Onshore Crude-Oil-Spill Rate for the Years 1989-1996

	1989-1996	
Total Volume of Spills 1 gallon	156,482	gallons
Total Barrels	3,725.76	barrels
Total Number of Spills	975	
Average Spill Size	3.8	barrels
Billion Barrels Produced	4.9	Billion barrels
Spills Per Billion Barrels Produced	199	Spills/Billion barrels

Source USDOI, MMS, Alaska OCS Region 1997
Oil-spill databases are from the ADEC, Anchorage, Juneau and Fairbanks
Alaska North Slope production data are derived from the TAPS throughput

Table IV.A.2-2 Oil-Spill-Occurrence Estimates for Crude Oil Spills 1 Gallon Resulting Over the Assumed Production Life of the NE NPR-A Planning Area: (a) First Sale and (b) Multiple Sales

Alternative	Resource Range (Bbbl)[1]	Spill Rate Spills/Bbbl[2]	Assumed Spill Size (bbl)[3]	Estimated Number of Crude Oil Spills[4]	Estimated Total Volume of Crude Oil Spills (bbl)[4]
		(a) First Sale			
Alternative A[5]	0.0 – 0.0	199	4.0	0 – 0	0 – 0
Alternative B[5]	0.065 – 0.350	199	4.0	0 – 70	0 – 280
Alternative C	0.075 – 0.410	199	4.0	15 – 82	60 – 328
Alternative D	0.185 – 0.825	199	4.0	37 – 164	148 – 656
Alternative E	0.250 – 1.1	199	4.0	50 – 219	200 – 876
		(b) Multiple Sales			
Alternative A[5]	0.0 – 0.0	199	4.0	0 – 0	0 – 0
Alternative B[5]	0.09 – 0.50	199	4.0	0 – 100	0 – 400
Alternative C	0.11 – 0.58	199	4.0	22 – 115	88 – 460
Alternative D	0.37 – 1.65	199	4.0	74 – 328	296 – 1,312
Alternative E	0.50 – 2.20	199	4.0	100 – 438	400 – 1,752

Source USDOI, MMS, Alaska OCS Region 1997 Notes [1] The estimation of oil spills is based on the estimated resources likely to leased, discovered, and produced as a result of the IAP, and assumes the existence of economically recoverable hydrocarbons in the planning area [2] Crude oil-spill rates were calculated using the ADEC spill database and North Slope production data [3] For purposes of analysis, the mean spill size of 3.8 bbl is rounded to 4.0 bbl [4] The estimated number and volume of spills is rounded to the nearest whole number [5] No exploration or development is assumed for Alternative A. The low end of the resource range for Alternative B is assumed to be exploration only

Table IV.A.2-3 Estimated Crude-Oil-Spill Size Distribution Resulting over the Assumed Production life of the Northeast NPR-A Planning Area: (a) First Sale and (b) Multiple Sales

Size[1]	Alternative A Estimated Number of Spills[2,3]	Alternative B Estimated Number of Spills[2,3]	Alternative C Estimated Number of Spills[2]	Alternative D Estimated Number of Spills[2]	Alternative E Estimated Number of Spills[2]
			(a) First Sale		
1 gallon	0 – 0	0 – 15	3 – 17	8 – 34	10 – 45
>1 and 5 gallons	0 – 0	0 – 25	5 – 28	13 – 58	17 – 77
>5 gallons and <1 bbl	0 – 0	0 – 13	3 – 16	7 – 31	10 – 42
Total <1 bbl	**0 – 0**	**0 – 53**	**11 – 61**	**28 – 123**	**37 – 164**
1 bbl and bbl 5	0 – 0	0 – 13	3 – 16	7 – 31	10 – 43
>5 and 25 bbl	0 – 0	0 – 3	1 – 4	2 – 8	2 – 10
> 25 and 1,000 bbl	0 – 0	0 – 1	0 – 1	0 – 2	1 – 2
Total >1 bbl	**0 – 0**	**0 – 17**	**4 – 21**	**9 – 41**	**13 – 58**
Total Volume (bbl)	**0 – 0**	**0 – 280**	**60 – 328**	**148 –656**	**200 – 876**
			(b) Multiple Sales		
1 gallon	0 – 0	0 – 21	5 – 24	15 – 68	21 – 91
>1 and 5 gallons	0 – 0	0 – 35	8 – 41	26 – 115	35 – 154
>5 gallons and <1 bbl	0 – 0	0 – 19	4 – 22	15 – 63	19 – 84
Total < 1 bbl	**0 – 0**	**0 – 75**	**17 – 87**	**56 – 246**	**75 –329**
1 bbl and bbl 5	0 – 0	0 – 19	4 – 22	14 – 64	19 – 85
>5 and 25 bbl	0 – 0	0 – 5	1 – 5	3 – 15	5 – 20
>25 and 1,000 bbl	0 – 0	0 – 1	0 – 1	0 – 3	1 – 4
Total >1 bbl	**0 – 0**	**0 – 25**	**5 – 28**	**17 – 82**	**25 – 109**
Total Volume (bbl)	**0 – 0**	**0 – 400**	**88 – 460**	**296 – 1,312**	**400 –1,752**

Source USDOI, MMS, Alaska OCS Region 1997 Notes [1] Spill-size distribution is allocated by multiplying the total estimated number of spills by the fraction of spills in that size category from the ADEC database [2] Estimated number of spills is rounded to the nearest whole number [3] No exploration or development is assumed for Alternative A. The low end of the resource range for Alternative B is assumed to be exploration only

Table IV.A.2-6
Oil-Spill-Occurrence Estimates for Refined Oil Spills ≥1 Gallon Resulting over the Assumed Production life of the Northeast NPR-A Planning Area: (a) First Sale and (b) Multiple Sales

Alternative	Resource Range (Bbbl)[1]	Spill Rate Spills/Bbbl	Average Spill Size (bbl)	Estimated Number of Spills[2]	Estimated Total Spill Volume (bbl)[2]
(a) First Sale					
Alternative A	0.0 – 0.0	464	0.7 (29 gal)	0 – 0	0 – 0
Alternative B	0.085 – 0.350	464	0.7 (29 gal)	0 – 162	0 – 112
Alternative C	0.075 – 0.410	464	0.7 (29 gal)	35 – 190	24 – 131
Alternative D	0.185 – 0.825	464	0.7 (29 gal)	86 – 383	59 – 265
Alternative E	0.250 – 1.1	464	0.7 (29 gal)	116 – 510	80 – 352
(b) Multiple Sales					
Alternative A	0.0 – 0.0	464	0.7 (29 gal)	0 – 0	0 – 0
Alternative B	0.09 – 0.50	464	0.7 (29 gal)	0 – 232	0 – 162
Alternative C	0.11 – 0.58	464	0.7 (29 gal)	51 – 269	36 – 188
Alternative D	0.37 – 1.65	464	0.7 (29 gal)	172 – 766	120 – 536
Alternative E	0.50 – 2.2	464	0.7 (29 gal)	232 – 1,021	162 – 715

Source: USDOI, MMS, Alaska OCS Region, 1997. Notes: [1] The estimation of oil spills is based on the estimated resources likely to leased, discovered, and produced as a result of the IAP, and assumes the existence of economically recoverable hydrocarbons in the planning area. [2] The fractional estimated mean spill number and volume is rounded to the nearest whole number.

moving off pads may have some potential to enter a river or waterbody. For purposes of analysis, the percent of crude-oil spills occurring on a pad versus off the pad onto the surrounding environment is estimated. Approximately 65 to 80 percent of all crude-oil spills occur on a pad and have little or no effect to the environment. Approximately 20 to 35 percent may occur on or reach the surrounding environment.

Those spills reaching the surrounding environment generally remain restricted to a limited area of the tundra unless they reach a river, stream, or waterbody. The ADEC records are not accurate enough to provide statistical spill-size areas. The following are comments based on the ADEC data. Off-pad spills that occur or reach the environment generally cover a small area (< 500 square feet [ft^2]). Larger contamination areas appear to occur by wind blowing a fine oil mist over a large area (up to 4.8 acres). Mueller (1997, pers. comm.) reports that a pipeline spill on December 30, 1993, at drill site 5, well 23, misted a fine oil spray over a tundra area of 100 to 145 acres. Of the off-pad spills that occur, many contact snow, which is cleaned up before the oil reaches the tundra. The ADEC database documents that a spill at Point McIntyre covered approximately 23 acres of snow-covered tundra with 142 bbl of crude oil. Because this area was snow covered, there was little impact to the surrounding environment. If this spill occurred during the summer, the impacts would have been very different. ARCO Alaska Inc. reports the largest tundra area impacted from a spill is approximately 1.50 acres (Joyce, 1997, pers. comm.).

(2) Blowouts: Blowouts represent several potential hazards. There is the danger of fatalities or serious injury to workers, equipment loss, and pollution. Blowouts usually are gas and oil combinations, but each type can occur separately. Gas blowouts are more dangerous and explosive but generally have a lesser effect on the environment compared to crude-oil blowouts.

The blowout rate for the Alaska North Slope is reviewed using the available data. The ADEC database does not identify well blowouts as a cause of spills from January 1989 to December 1996 nor at any other time (Stevens, 1997, pers. comm.). On the Alaska North Slope from 1958 to 1996, 2,933 wells were drilled (McManes, 1997, pers. comm.). During that same time period, the Alaska Oil and Gas Conservation Commission (AOGCC) reports one crude-oil blowout (Wondzell, 1997, pers. comm.). No crude oil was spilled off the pad during this blowout. Loss of well control has occurred on some operations resulting in the release of dry gas from high-pressure zones and the consequent showering of rocks and sand over areas reached by the blowout plume (Johnston, 1997).

Based on the Alaska North Slope blowout data, the chance of a blowout during drilling and nondrilling operations in the planning area is considered a very low-probability event. The long- duration, large-volume blowouts of the very early years of oil and gas exploration and development do not occur in the recent record. The present technology associated with blowout prevention and effective well control has reduced the incidence of well blowouts. In the unlikely event of a blowout, several factors reduce the risk to the environment. Most blowouts are gas or bridge themselves naturally in a short period of time. For purposes of analysis, no blowouts are assumed in this EIS.

(3) Crude-Oil Spills Associated with Delivery of NPR-A Crude Oil through TAPS: The TAPS pipeline crude-oil-spill rate is calculated for the period January 1989 to December 1996. The estimated crude-oil-spill rate

288

Table IV.A.2-7
Oil-Spill Rates and Spill-Size Categories used in the Estimation of Oil Spills for the Cumulative Case

Category	Resource Range (Bbbl)[1]	Crude Oil Spill Rates Spills/Bbbl	Crude Oil Spill-Rate Size Category	TAPS Pipeline Crude-Oil-Spill Rate	TAPS Pipeline Spill-Rate Size Category	TAPS Tanker Crude-Oil-Spill Rate	TAPS Tanker Spill-Rate Size Category
Federal Offshore	0.22 - 0.55	1.77[1]	≥1,000 bbl	14[3]	≥1 gal	1.10[4]	≥1,000 bbl
State Offshore	0.6 - 1.10	1.77[1]	≥1,000 bbl	14	≥1 gal	1.10	≥1,000 bbl
State Onshore	5.4 - 9.9	199[2]	≥1 gal	14	≥1 gal	1.10	≥1,000 bbl
NE NPR-A[5]	0.50 - 2.20	199[2]	≥1 gal	14	≥1 gal	1.10	≥1,000 bbl
W NPR-A	0.13 - 1.2	199[2]	≥1 gal	14	≥1 gal	1.10	≥1,000 bbl

Source: USDOI, MMS, Alaska OCS Region, 1997. [1] The estimated spill rate for pipelines and platforms on the OCS (Anderson and LaBelle, 1994). [2] The estimated spill rate for the Alaska North Slope onshore platforms, pipelines, and facilities calculated from the ADEC database and North Slope production data. [3] The estimated spill rate for the TAPS pipeline calculated from the ADEC and JPO databases and North Slope production data. [4] The estimated spill rate for TAPS tankers (Anderson and LaBelle, 1994). [5] The NE NPRA resource assumed for the cumulative case is the multiple sale Alternative E.

Table IV.A.2-8
Cumulative Case Oil-Spill-Occurrence Estimates ≥1 Gallon Resulting from Foreseeable Operations over the Assumed Production life of the Northeast NPR-A Planning Area

Offshore Spills	Category	Resource Range (Bbbl)[1]	Crude-Oil-Spill Rates Spills/Bbbl	Spill-Rate Size Category	Average Spill Size	Most Likely Number of Beaufort Sea Spills	Chance of One or More Spills Occurring
	Federal Offshore	0.22 - 0.55	1.77	≥1,000 bbl	7,000 bbl	0 - 0	32-62%
	State Offshore	0.70 - 1.2	1.77	≥1,000 bbl	7,000 bbl	1 - 2	71-88%
	Total Offshore Spills					1 - 2	

Onshore Spills	Category	Resource Range (Bbbl)[1]	Crude-Oil-Spill Rates Spills/Bbbl	Spill-Rate Size Category	Average Spill Size	Estimated Number of Crude-Oil-Spills Onshore	Estimated Volume of Crude-Oil-Spills (bbl)
	State Onshore	6.3 - 10.8	199	≥1 gal	4 bbl	1,254 - 2,149	5,016 - 8,596
	NE NPR-A[2]	0.50 - 2.2	199	≥1 gal	4 bbl	100 - 438	400 - 1,752
	W NPRA	0.13 - 1.2	199	≥1 gal	4 bbl	26 - 239	104 - 956
	Total Onshore Spills					1,380 - 2,826	5,520 - 11,304

TAPS Pipeline Spills	Category	Resource Range (Bbbl)[1]	TAPS Spill Rates Spills/Bbbl	Spill-Rate Size Category	Average Spill Size	Estimated Number of TAPS Spills	Estimated Volume of TAPS Spills (bbl)
	Federal Offshore	0.22 - 0.55	14	≥1 gal	1.1 bbl	3 - 8	3 - 9
	State Offshore	0.70 - 1.2	14	≥1 gal	1.1 bbl	10 - 17	11 - 19
	State Onshore	6.3 - 10.8	14	≥1 gal	1.1 bbl	88 - 151	97 - 166
	NE NPR-A[2]	0.50 - 2.2	14	≥1 gal	1.1 bbl	7 - 31	8 - 34
	W NPRA	0.13 - 1.2	14	≥1 gal	1.1 bbl	2 - 17	2 - 19
	Total Pipeline Spills					110 - 224	121 - 247

TAPS Tanker Spills	Category	Resource Range (Bbbl)[1]	TAPS Tanker Spill Rates Spills/Bbbl	Spill-Rate Size Category	Average Spill Size	Most Likely Number of Tanker Spills	Chance of One or More Spills Occurring
	Federal Offshore	0.22 - 0.55	1.1	≥1,000 bbl	30,000 bbl	0 - 0	21 - 46%
	State Offshore	0.70 - 1.2	1.1	≥1,000 bbl	30,000 bbl	0 - 1	54 - 73%
	State Onshore	6.3 - 10.8	1.1	≥1,000 bbl	30,000 bbl	6 - 11	>99.99 - >99.99%
	NE NPR-A[2]	0.50 - 2.2	1.1	≥1,000 bbl	30,000 bbl	0 - 2	42 - 91%
	W NPR-A	0.13 - 1.2	1.1	≥1,000 bbl	30,000 bbl	0 - 1	13 - 73%
	Total Tanker Spills					6 - 15	

Source: USDOI, MMS, Alaska OCS Region, 1997. Notes: [1] The estimation of oil spills is based on the estimated resources likely to leased, discovered, and produced as a result of the IAP, and Federal and State existing and known reserves and assumes the existence of economically recoverable hydrocarbons in these areas. [2] The NE NPRA resource assumed for the cumulative case is the multiple sale Alternative E.

Table IV.A.2-9
Cumulative Case Summary: Crude Oil-Spill-Occurrence Estimates

Category	Estimated Number of Spills	Estimated Volume of Spills (bbl)	Contribution to the Cumulative Case
Offshore Spills			
Beaufort Sea	1 – 2	7,000 – 14,000	100 – 100%
NE NPR-A	0 – 0		0 – 0%
Onshore Spills			
Onshore Spills	1,270 – 2,389	5,120 – 9,552	92 – 85%
NE NPR-A	100 – 438	400 – 1,752	8 – 15%
TAPS Pipeline Spills			
TAPS Pipeline Spills	103 – 211	111 – 213	98 – 94%
NE NPR-A	7 – 31	8 – 34	2 – 6%
TAPS Tanker Spills[1]			
TAPS Tanker Spills	6 – 13	180,000 – 390,000	100 – 87%
NE NPR-A	0 – 2	0 – 60,000	0 – 13%

Source: USDOI, MMS, Alaska OCS Region, 1997. Note: [1] TAPS tanker spills are calculated for the entire TAPS route, and these estimated spills may occur at any location along the TAPS route. The percentage of total shipments, 1986-1992 averages, are as follows: Alaska, 3.3%; Puget Sound, Wash., 25.3%; San Francisco, Calif., 16.2%; Los Angeles, Calif., 27.1%; Hawaii, 3.2%; Panama, 20.6%; and the U.S. Virgin Islands 4.5% (Anderson and Lear, 1994).

for TAPS pipeline spills >1 gal is 14 spills per billion barrels produced. The average crude-oil-spill size is 1.1 bbl. The database spill sizes range from 1 teaspoon to 18.3 bbl; however, only spills >1 bbl are analyzed. Table IV.A.2-4a shows the estimated TAPS pipeline crude-oil spills for Alternatives A through E resources developed in the first sale. Table IV.A.2-4b shows the estimated TAPS pipeline spills from resources developed over multiple-sale Alternatives A through E.

The TAPS tanker-spill rate for the period 1977 to 1992 is taken from Anderson and LaBelle (1994). The TAPS tanker-spill rate is 1.10 spills per billion barrels produced. The average crude-oil-spill size is 29,800 bbl, and the median is 4,900 bbl. For purposes of analysis, the average crude-oil-spill size is assumed to be 30,000 bbl. Table IV.A.2-5a shows the estimated TAPS tanker crude-oil spills for Alternatives A through E based on resources developed in the first sale. Table IV.A.2-5b shows the estimated TAPS tanker crude-oil spills for resources developed over multiple-sale Alternatives A through E.

b. Refined-Oil Spills: The typical refined products spilled are aviation fuel, diesel fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. Diesel spills are 61 percent of refined-oil spills by frequency and 75 percent by volume. Refined-oil spills occur in conjunction with oil exploration and production. The refined-oil spills correlate to the volume of Alaska North Slope crude oil produced. As crude-oil production has declined so has the number of refined-oil spills. From January 1989 to December 1996, the refined-oil-spill rate is 464 spills per billion barrels produced. Table IV.A.2-6a shows the estimated refined oil spills during the lifetime of the IAP for Alternatives A through E. Table IV.A.2-6b shows the estimated refined-oil spills during the lifetime of the IAP for multiple-sale Alternatives A through E.

c. Cumulative Case: The estimated resources and reserves used for analytical purposes in the cumulative case are shown in Table IV.A.5. In the cumulative case, the assumed resources for the planning area are a multiple sale Alternative E. The TAPS pipeline, Alaska North Slope, TAPS tankers, and the Alaska OCS all have different spill rates and spill-size categories used in the estimation of oil spills for the cumulative case. Table IV.A.2-7 shows the spill rates and spill-size categories used for each. For the cumulative case, the average pipeline and platform spill in the Beaufort Sea is assumed to be 7,000 bbl (Anderson and LaBelle, 1994). The average spill size for other categories is indicated above or in Table IV.A.2-7. Tables IV.A.2-8 and 9 show the estimated spill occurrence for the cumulative case in detail and in summary, respectively.

3. Fate and Behavior of Oil Spills:

The average crude-oil spill anticipated to occur as a result of the proposed action would be 4 bbl; therefore, the fate and behavior of this size spill is most relevant and is emphasized in this section. The description of general behavior and weathering of oil spills on arctic waters, on ice or snow, or underneath ice cover, as contained in Section IV.A.3 of the Sale 144 Final EIS (USDOI, MMS, 1996a), is herein incorporated by reference. A summary, supplemented by additional material, as cited, follows.

Weathering Processes: Several processes alter the chemical and physical characteristics and toxicity of spilled oil. Collectively, these processes are referred to as weathering or aging of the oil and, along with the hydrology and meteorology, the weathering processes determine the oil's fate. The major oil-weathering processes are spreading, evaporation, dispersion, dissolution, and emulsification. Lesser roles are played by photooxidation and microbial degradation. The fate of weathering oil spilled into or entering surface waters also involves wind, wave, and current movement of the slick; sedimentation to the bottom; and stranding onto vegetation or shoreline.

Environmental Factors: The type of spill, the time of year, and the environment it occurs in—such as a land spill; a freshwater spill; a marine spill; or spill on, in, or under ice—will affect how an oil spill behaves and weathers. Weathering processes generally would be similar in NPR-A freshwater and coastal marine regimes. Seasonal ice cover can greatly slow weathering in both regimes.

Oil spreading on the water surface (but not necessarily the advection of oil with moving water) would be restricted in most NPR-A waters. In NPR-A lake, river, and marine waters, oil spills would spread less than in temperate fresh- or temperate marine waters due to the increased oil viscosity in cold water. Spills into shallow, marshy or ponded tundra or into flooded lake margins in summer could spread more rapidly, similarly to a temperate spill. This greater spreading is because these shallower waters can reach temperatures up to 18 °F warmer than other tundra waters (Miller, Prentki, and Barsdate, 1980), which decreases slick-oil viscosity. However, oil spreading of small to large spills in such wet tundra would be restricted by the topography. Although the tundra relief is low, it is sufficient to severely limit the spread of spills. During summer, flat coastal tundra develops a dead-storage capacity averaging 0.5 to 2.3 in (Miller, Prentki, and Barsdate, 1980), which would retain 300 to 1,500 bbl of oil per acre. Even at high-water levels, the tundra vegetation tends to act as a boom, and vegetation and peat as a sorbent, allowing water to filter through, trapping the more viscous oil (e.g., Barsdate et al., 1980) and also making recovery of the oil more difficult. On the other hand, even small spill spills can be spread over large areas, if the spill event includes aerial, pressured discharge. For example, in December 1993, ARCO Drill Site line failed, and 1 to 4 bbl of crude oil misted over an estimated 100 to 145 acres (Ott, 1997).

An oil spill in broken ice would spread between icefloes into any gaps greater than about 3 to 6 in. During most of "winter," from September until April, an oil spill under lake ice would spread into under-ice hollows and be encapsulated by freezing ice below the oil. In river or coastal marine waters, the oil-contaminated area may be increased through movement of oil by currents underneath the ice, until the oil was encapsulated by freezing ice. Encapsulated oil would not weather until the ice melts or brine channels allow upward oil flow. Water flow under ice in ponds, lakes, streams, and most river sections in the NPR-A should be insufficient to move sub-ice oil.

Evaporation of oil generally is linear with temperature change (Fingas, 1996). The lower the temperature, the slower crude oil evaporates. Both Prudhoe Bay and Endicott crudes have this pattern (Fingas, 1996). Oil between or on icefloes evaporates at a rate similar to that on open water at the same temperature. Oil that is frozen into the underside of ice is unlikely to undergo any evaporation until its release in spring. Because freshwater and multiyear ice do not have enough salts to form brine channels, the oil would be released only as the ice surface ablated to the level of the encapsulated oil. For freshwater ice, this would be when the ice became porous within about 2 weeks of meltout, from May to July, depending on weather, ice thickness, and location of the oil in the ice. In multiyear ice, surfacing of the oil probably would not occur until August, and some oil would not be released until a second summer. In first-year sea ice, the encapsulated oil will rise to the surface through brine channels in the ice in May or June, before visible ice degradation occurs. As oil is released to the surface, evaporation will occur. How much oil evaporates is highly dependent on the specific chemistry of the spilled oil and also on competing pathways, such as dispersion. For Prudhoe Bay crude, about 20 percent of spilled oil could be expected to evaporate within 30 days following a summer spill or meltout of a winter spill.

Dispersion of oil into the underlying water requires mixing energy generally supplied by wind, waves, or currents. Some additional oil dispersion occurs in dense, broken ice through grinding action. More viscous and/or weathered crudes may adhere to porous ice, essentially concentrating oil within the icefield and limiting the oil dispersion.

Emulsification of some crude oils is increased in the presence of ice. If wave action grinds ice pieces together, Prudhoe Bay crude forms a mousse within a few hours—an order of magnitude more rapidly than in open water.

The NPR-A Oil-Spill Experiment: On July 16, 1970, 5 bbl (not 4 bbl, Prentki, 1997, pers. comm.) of Prudhoe Bay crude was experimentally spilled in a 0.07-acre tundra Pond E in the NPR-A near Barrow (Miller, Alexander, and Barsdate, 1978; Barsdate et al., 1980; Hobbie, 1982). The general behavior of this experimental spill is instructive in what to expect for both an average-sized NPR-A summer spill or for a winter spill that melts outs during thaw.

In this experimental spill, the oil spread over the water surface within a few hours to a 0.06-in thickness. Within 24 hours, the slick thickened as lighter hydrocarbons evaporated and shrunk into a 10- to 16-ft band on the downwind side of the pond. For about a month, the oil moved back and forth across the pond, shifting sides with changes in wind direction. Gradually, the oil worked part way into the pond's vegetated margins. By the end of summer, all of the oil was trapped along the pond margins either on the water's surface or on the bottom. No oil left the pond during the next spring runoff, despite significant water throughflow. Half of the oil was estimated to be evaporated or degraded within a year, but the rest of the oil remained with little change for at least 5 years. Sedges oiled at the waterline along the pond margins did not suffer visible damage the first summer. However, during subsequent years, their new leaves were unable to penetrate oil mats, which killed the plants under the mats. The waters of the oiled pond remained toxic to more sensitive zooplankton species for 7 years. There also were long-term (several-year) observable effects on phytoplankton and insect population and shorter term effects on benthic algae and microbe populations.

4. Spill-Prevention and Response: Each permittee operating on the NPR-A is required to have an "Oil-Spill-Response Plan," with trained personnel and cleanup equipment and supplies at each activity site to meet Federal, State, and Borough regulations. An activity site would be the exploration site, drilling site, or production site, each with its ancillary facilities. Federal regulations that need to be met are BLM oil and gas operating regulations 43 CFR 3160, Onshore Order No's. 1, 2, and 6. These regulations deal with the prevention and control of oil spills and releases. Regulations 40 CFR 110 and 300 deal with responses to spills or releases of oil and gas. Spill response and requirements would be thoroughly addressed when and if parcels are leased. For example, an Application for Permit to Drill would be evaluated for spill response regarding chemicals onsite and blowout prevention equipment required as well as the size of the reserve pit in relation to hole depth and size. These requirements all are addressed in Onshore Order No. 2. Onshore Order No. 6 would address any anticipated hydrogen sulfide releases. These conditions are all very site specific. State regulations that have to be met are covered in AS 46.03.020(10)(A) and are administered by the ADEC.

The response plan includes an action plan and a list of contacts in State and Federal Agencies with direct responsibilities in the event of a spill and private companies that can be called on for further information or assistance. The environmental obligations of operators on a Federal onshore lease are described in BLM regulations contained in 43 CFR 3160, Oil and Gas Operating Rules. In addition, parts or all of several Onshore Oil and Gas Orders may apply, as necessary.

The BLM is delegated the authority to ensure that a drilling well is under control. If the well control is lost (blowout), the BLM oversees all actions needed to bring the well under control. The BLM has the authority to cite the operator ~~and bring civil and/or criminal charges to bear~~. If there is a spill or release of petroleum fluids or chemicals used in the petroleum industry on the lease, unit, or participating area, BLM has the authority to cite the operator and direct cleanup. However, cleanup will be done in cooperation with other Federal or State Agencies.

The BLM requires that all spills or other undesirable events be reported to their authorized officer within 24 hours of the event. The BLM oversees the work of the lessee or operator to ensure that all spills or undesirable events are appropriately cleaned up in accordance with all applicable laws and regulations. (Undesirable events are defined in Notice to Lessees [NTL]-3A, as spills or releases of petroleum fluids or chemicals used in the petroleum industry.)

The ADEC is responsible as the On-Scene Coordinator (OSC) for spills on most lands within the State. The U.S. Coast Guard (USCG) is responsible for directing spill cleanup on areas of tidewater and the seas. The OSC must ensure compliance with all Federal and State laws. The intent of the applicable laws and regulations is to prevent, as much as possible, hazardous materials from entering water and to ensure the rapid removal of these substances from areas where there is a danger of contaminating water. The OSC monitors and documents the operator's actions and determines when the cleanup is satisfactory in coordination with the surface-land manager. The OSC instructs those responsible for the spill as to what additional measures are to be taken.

5. Major Projects Considered in the Cumulative Case: Major projects considered in the cumulative case all are related directly to the oil and gas industry. This is due not only to the nature of the plan under review but also to the fact that oil and gas development is the principal agent of industrial-related change on the North Slope. The analysis of major oil and gas projects considered in the cumulative case is based on the price of a barrel of oil ranging between $18 to $30 over the life of the proposed action. This range applies only to the infrastructure and resources of existing fields. Accordingly, the IAP largely is analyzed in its relation to existing and producing fields; this analysis does not speculate on development from myriad potential off- and onshore fields. The timing, location, development, resource levels, and infrastructure requirements of yet-undeveloped (if not undiscovered) fields are a matter of extreme conjecture.

a. Resource Contribution of the Northeast NPR-A Planning Area to the Cumulative Case: The contribution of planning area resources to the

Table IV.A.5-1
Resource and Reserve Estimates Used for Analytical Purposes in the Cumulative Case

	Bbbl Estimated to be Leased, Developed, and Produced
Federal Offshore	0.22 – 0.55
State Offshore	0.7 – 1.2
State Onshore	6.30 – 10.8
Planning Area (Maximum)	0.50 – 2.2
Western NPR-A[1]	0.13 – 1.2

Source: USDOI, MMS, 1997, Alaska Report, 1997, and State of Alaska, DNR, 1996. [1] Preliminary Estimate (USDOI, MMS, 1997)

cumulative case is based upon a multiple-sale estimation. Should all of the planning area's oil resources be leased and developed, it is estimated that production would range between 500 Mmbbl and 2.2 Bbbl. In this event, NPR-A resources could range between 8 percent (at $18 bbl) to as much as 20 percent (at $30 bbl) of current forecasted North Slope oil resources. However, the range of production depends on whether the price of a barrel of oil was closer to $18 or $30 (in terms of 1997 dollars).

b. Projected North Slope Oil Production from Current Fields: Oil resources forecast for current State and Native fields and onshore Federal fields on the North Slope range between 7.85 Bbbl (at $18 bbl) and 15.95 Bbbl (at $30 bbl). The 7.85-Bbbl estimate refers to a production forecast for reserves in known and developed fields. The 15.95-Bbbl estimate refers to reserve additions (acquired by infill drilling and enhanced recovery) in known fields, the development of satellite pools adjacent to existing infrastructure, and the accelerated development of heavy oil accumulations. Ten percent of this range is attributed to offshore State lands. Table IV.A.5-1 shows estimated cumulative-case resource and reserve estimates.

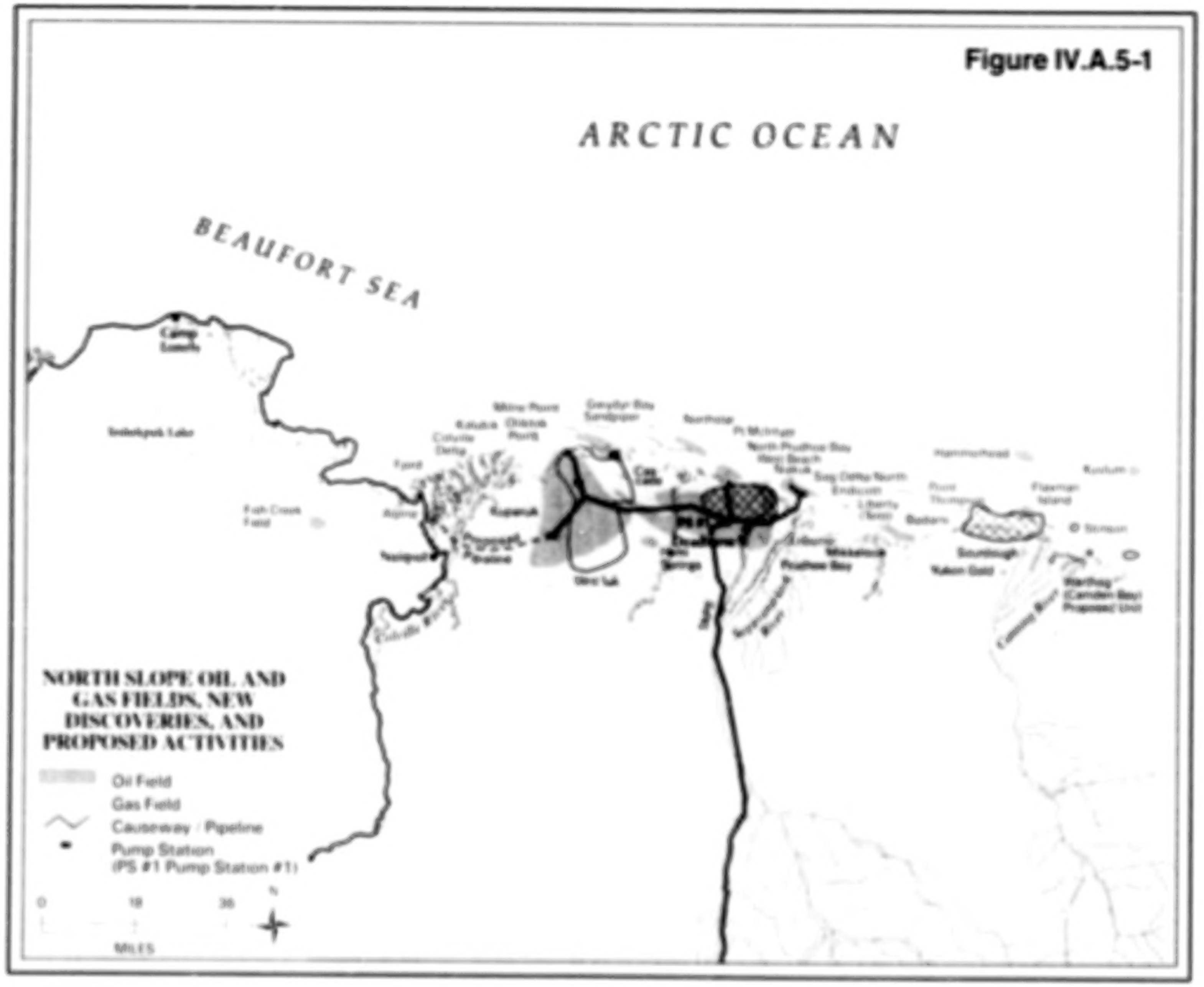
Since the first production well was drilled on the Prudhoe Bay structure, North Slope fields produced a cumulative total of 11.343 Bbbl of oil (by the end of 1996). Production on the North Slope peaked in 1988 at 2.0 MMbbl of oil per day and subsequently has declined to 1.36 MMbbl per day. Of the 11 producing fields on the North Slope, the most productive, in order, are Prudhoe Bay, Kuparuk River, Point McIntyre, and Endicott. Figure IV.A.5-1 indicates producing field locations as well as recent discoveries within the North Slope petroleum province. The State of Alaska estimates that the combined production from the presently operating and to-be-developed fields will decline to a daily output of 442 MMbbl in 2015. The State expects that cumulative production of oil from 1997 to 2020 will be approximately 6.47 Bbbl (State of Alaska, DNR, 1997).

During 1996, ARCO announced that the Alpine Prospect, located in the Colville River delta, was producible and contained an estimated 365 MMbbl of recoverable reserves. It is the closest developing oilfield to the area under study. The project is expected to come online as early as 2000, with peak production reaching 18 to 29 MMbbl annually. Alpine resources are to be extracted from two gravel drill pads connected by a 3-mi long road. A 5,420 ft runway is to be constructed as a wide spot in the highway. Produced crude would be transported via a 34.2-mi pipeline to a Kuparuk oilfield processing facility, where Alpine production would be commingled with Kuparuk output. The Alpine pipeline would cross the Colville channel via bored holes. Ice roads and bridges would support construction and function as winter supply routes; no gravel roads connecting the Kuparuk infrastructure to Alpine will be built (Parametrix et al. 1996). British Petroleum is developing plans to produce the offshore Northstar Unit. Due to Federal permitting requirements and the fact that some of the production will be from Federal tracts, A Developmental EIS is being written for Northstar. British Petroleum estimates that Northstar will produce 145 MMbbl of oil over a15-year period. Additionally, there are a number of ongoing drilling efforts in the Prudhoe-Kuparuk region. New well locations are shown in Figure IV.A.5-1.

c. Projected Oil and Gas Lease Sales: Beginning in 1998, the State will conduct annual areawide lease sales in the Beaufort Sea and along the Arctic Slope. Including the Foothills Areawide Lease Sale of 2001, the State will offer nine lease sales over the next 5 years. As the term areawide implies, these State lease sales will be extensive. Each time the State Beaufort Sea area is offered, the offering will extend from Barrow to the Canadian border; while onshore Arctic Slope sales will put up for sale on each occasion all unleased State lands between the Arctic National Wildlife Refuge (ANWR) and the NPR-A. The State of alaska has no oil and gas resource estimates for its future leas sales.

d. OCS Lease-Sale Activity and Contribution to the Cumulative Case: Since December 1979, the U.S. Department of the Interior (USDOI) has conducted six lease sales in Federal Beaufort Sea waters. The seventh lease sale, Sale 170, is scheduled for September 1998. The most recent was Sale 144 in September 1996. During the life of Federal leasing in the Beaufort Sea, 660 leases have been sold totaling 2.8 million acres. Some 28 wells have been drilled on Federal leases, with 9 wells determined as producible. All wells have been plugged and abandoned, because field economics have not been favorable for production. Currently, there are 76 active leases on Federal submerged lands in the Beaufort Sea. Potentially producible prospects within Federal waters lie in the Kuvlum and Hammerhead Units (Fig. IV.A.5-1).

Figure IV.A.5-1



NORTH SLOPE OIL AND GAS FIELDS, NEW DISCOVERIES, AND PROPOSED ACTIVITIES

▨ Oil Field
Gas Field
Causeway / Pipeline
● Pump Station (PS #1 Pump Station #1)

BEST COPY AVAILABLE

BLANK PAGE

However, no adequate resource assessment is available for these two units. The Northstar Unit contains some Federal tracts and, although the majority of submerged tracts comprising this unit lie under State waters, the amount of Federal oil to be produced by this development has yet to be determined. Should the Northstar Unit be developed, a pipeline shore-approach abutment may be constructed just west of Point McIntyre to protect the pipe from nearshore ice forces.

Beaufort Sea OCS resources under lease, including Sale 144 and existing leases, are 220 to 550 MMbbl. The low end of the range represents potential development at the $18 bbl estimate and includes the Liberty Prospect (Tern Island). The $30 bbl figure includes discovered but noncommercial fields (e.g., Kuvlum), which are likely to be developed at higher prices. Remaining oil resources that may be available and are estimated to be leased, discovered, and developed in proposed lease Sale 170 are 350 to 670 MMbbl. See Table IV.A.5-1 for cumulative-case resources estimates. No estimates have been made for the Warthog Prospect off ANWR, as the operators are still in the process of seeking permits for exploratory drilling.

e. Infrastructure and Transportation: Given the decline of the North Slope fields and the uncertainty of the North Slope's output being replaced by any other oil source, it is more than likely that as long as the TAPS is operational, the system will have surplus capacity to process and transport any hydrocarbons produced by NPR-A production or any other projected development activity.

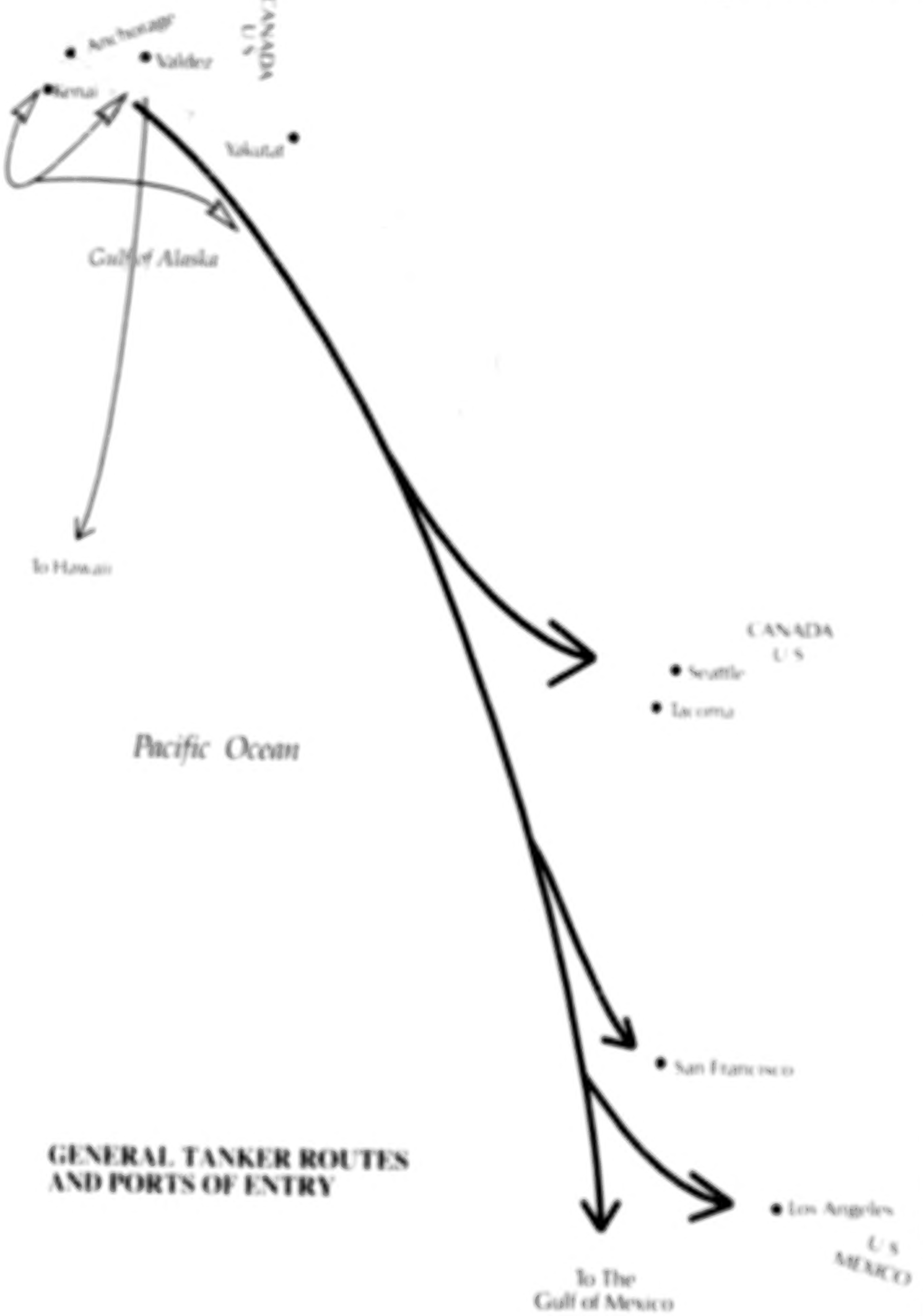
Currently, approximately 600 tanker trips are made annually from Valdez. Given an estimation of future North Slope production (including offshore) at the high end of current projections, by 2009, oil-tanker traffic from Valdez still could be in the range of 500 to 600 trips annually. The contribution of Valdez tanker-transport traffic resulting from a single 1998 sale in the IAP is expected to range from 4 to 7 percent in 2009 (1 year after field startup) to 10 percent in 2016 (field maximum under the $30 bbl) at the height of production. Should all resources (including those from currently undeveloped sources) be recovered, the percentage of tanker traffic related to the first sale would fall substantially and would become a minor percent of oil-related traffic (see Fig. IV.A.5-2 for oil-tanker routes). Referring to subsection a (above), should multiple sales occur within the NPR-A over the next 15 years, the quantities of crude oil produced from the NPR-A may double; in that case, tanker loadings created by the IAP would form a significant component of Valdez tanker traffic well into the next century.

f. Tanker Traffic and Routes: Potential crude oil (and possibly liquefied natural gas [LNG]) tankerage from Valdez to the Far East will join existing LNG tanker traffic from the LNG plant in Nikiski, Alaska. The Nikiski plant is the only facility in the U.S. that liquefies natural gas. Every 10 days, the Nikiski facility loads an 80,000-cubic meter (m^3) LNG tanker for a round trip to Tokyo. The Nikiski facility has been transporting LNG via tanker to Japan since 1968 without significant spillage. Because LNG would boil off and disperse quickly when exposed to normal air temperatures and North Pacific winds, it is not considered a substantive environmental threat along the tanker route.

On November 28, 1995, President Clinton signed legislation (30 U.S.C. 185(s)) that authorizes the export of Alaskan North Slope crude oil when transported in U.S. flag tankers, unless the President should find such exports are not in the national interest. The lifting of the oil-export ban raises the possibility of some tanker traffic to the Far East from production generated under the IAP. Figure IV.A.5-3 indicates the probable route that tankers bound from Valdez to the Far East would be traveling, including tankers carrying oil produced under the IAP. Alaska-generated crude oil being shipped to the Far East along the indicated tanker route is expected to range between 60 and 90 MMbbl during 1997. By 2000, the annual transported quantity of crude oil could drop to 9 MMbbl; however, such estimates are highly speculative as much of the eastbound oil may rely on opportunistic short-term contracts. The routing indicated in Figure IV.A.5-3 would bring the tankers more than 200 mi offshore of the Aleutian Islands. At such a distance, any pollution event is expected to have a minimal effect on the biological resources of the Aleutian Chain.

g. Trans-Alaska Gas System (TAGS): If the price per barrel of crude oil reaches or remains close to the high end of the price range ($30), the economic climate may be such that the TAGS may be constructed. Discussed for several years, the TAGS would deliver North Slope natural gas at a rate of 2.3 billion cubic feet per day (bcfd) to a liquefaction plant terminal located in Valdez. The natural gas would be delivered in a 42-in pipeline that would be constructed across Alaska immediately adjacent to the TAPS. The proposed project would consist of a 2.1-bcfd natural gas-liquefaction plant, four 800,000-bbl LNG-storage tanks, a marine loading facility, and a cargo personnel loading dock. The proposed LNG plant would be sited in Anderson Bay 3 mi east of the Valdez narrows on the south shore of Port Valdez. The site is 3.5 mi west of the existing TAPS terminal and 5.5 mi from the community of Valdez. When completed, the facility would occupy 390 acres of a 2,630-acre site owned by the State of Alaska. A fleet of 15 LNG tankers, each with a capacity of 125,000 m^3, would transport the LNG to destinations in Japan, Taiwan, and Korea. Full project development would require 275 tanker loadings a year (Federal Energy Regulatory Committee, 1995). A final EIS was issued for

Figure IV.A.5-2



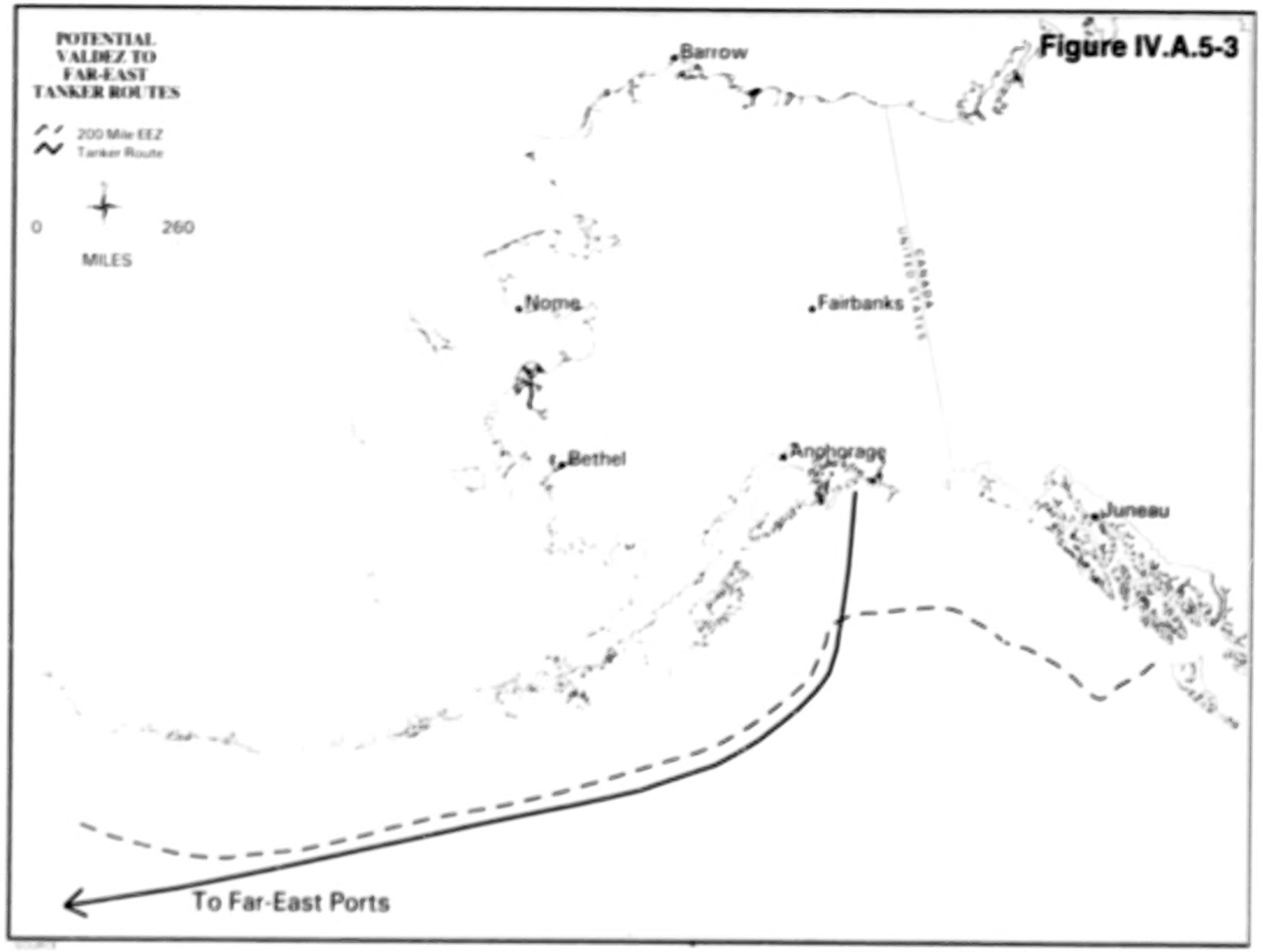
GENERAL TANKER ROUTES
AND PORTS OF ENTRY

296

BLANK PAGE

Figure IV.A.5-3

POTENTIAL VALDEZ TO FAR-EAST TANKER ROUTES



BEST COPY AVAILABLE

the TAGS LNG plant in March 1995; however, no agreements have yet been reached with the resource holders.

6. Additional Background Assumptions:

a. Environmental Justice: Executive Order 12898 signed by President Clinton on February 11, 1994, requires Federal Agencies to identify and address disproportionately high and adverse human health and environmental effects of its actions on minority and low-income populations. (U.S. Department of Energy, 1997). The intent is to promote fair treatment of all races and the poor, so no person or group of people shoulders a disproportionate share of the negative environmental impacts of Federal actions.

The NSB's 1993 census found that of the 6,538 Borough residents, 73.9 percent were Inupiat. Barrow's population was 61 percent Inupiat, while that of Nuiqsut and Atqasuk were 92 and 94 percent Inupiat, respectively. (NSB, 1994).

Based on U.S. Department of Commerce (USDOC) data, the Alaska Department of Labor (ADOL) has portrayed the NSB as having one of the highest per capita incomes in the State. Based on data it collected for its 1993 census, the NSB takes exception to these figures. The difference in perception depends primarily on different methods used in data collection. Federal data uses a sampling procedure, but the NSB conducts house-to-house surveys of households. Also, Federal figures include "transfer payments" such as unemployment, welfare, Social Security, and Medicare/Medicaid payments. The NSB survey includes all income reported to the Internal Revenue Service, including Alaska Permanent Fund and Alaska Native Claims Settlement Act (ANCSA) corporation dividends. The NSB figures determined an average household income of $54,645 and a per capita income of $15,218 in 1993. The average Inupiat household income was $44,551; that for non-Inupiat households was $74,448. The average Inupiat per capita income was $10,767 and the non-Inupiat per capita income was $29,725. Of all the households surveyed in the NSB, 23 percent qualified as very-low-income households, and another 10 percent qualified as low- to moderate-income households. As 66 percent of the total households surveyed were Inupiat, a substantial portion of the households falling in the very-low- to low-income range are Inupiat. Poverty-level families in the NSB numbered 88, or 6 percent of all households (NSB, 1994).

As described in Section III.C.3, subsistence activities in the planning area are important to providing dietary sustenance to North Slope residents. As a consequence, impacts to subsistence resources and access to those resources have a direct relationship to the analysis of which alternatives may have a disproportionately adverse effect on the minority and low-income populations. Those alternatives identified in the ANILCA 810 analysis in Appendix D as having a potentially significant impact on subsistence, also would have a significant impact on minorities and low-income populations and communities. Those stipulations and other protective measures that help to mitigate impacts on these groups of people for each alternative are the same as identified in the subsistence and the sociocultural analyses in Section IV.

b. Sacred Sites: Executive Order (E.O.) 13007 signed by President Clinton on May 24, 1996, requires Federal Agencies to avoid adversely affecting Native American sacred sites and to accommodate access and ceremonial use of such sites "to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions." A sacred site is "any specific, discrete, narrowly delineated location" on Federal land identified by Native tribes or a representative of a Native religion as "sacred by virtue of its established religious significance." To date, no such sites have been identified in the planning area. If any sacred sites are identified during the comment period, BLM will analyze the impacts of the Proposed Action on the sites and address mitigating actions that could protect them.

c. Energy Requirements and Conservation Potential of Various Alternatives and Mitigation Measures: There would be no unusual energy requirements for implementing any of the alternatives.

B. ALTERNATIVE A: The No Action Alternative is designated as Alternative A and reflects BLM's current management of the resources within the NPR-A. Activities that might impact these resources include the presence of humans, aircraft use, and activities associated with ground-based transport of personnel, supplies and equipment; vehicle traffic; resource surveys and camps; overland moves; and recreational activities. Under existing management, seismic activity would continue to be permitted and, for the purpose of analysis of impacts, is addressed in this section. An option under this alternative would be to prohibit seismic activity. The impacts of this no-seismic option are the same as those described for current management except for those impacts identified as being related to seismic activity. Typical seismic operations are described in Section IV.A.1.c. Stipulations to protect the resources under this alternative are described in Section II.C.7. Management actions under Alternative A would not include oil and gas lease sales or proposals for new land use classifications such as Special Areas.

1. Soils: Ground-impacting-management actions within the planning area that may affect soils under Alternative A include aircraft use, excavation and collection, ground activities, hazardous- and solid-material removal and remediation, and recreation—all of which occur during summer-early fall (June-September), except for winter activities such as recreation and subsistence. If the vegetative cover remains unaltered, these activities generally would have only a small impact. However, where these activities concentrate surface disturbance (e.g., foot traffic around a landing site or repeated snowmachine crossing of a drainage channel at the same site), there could be damage to the soils. If the vegetative cover is disturbed or the surface organic mat is removed or worn, soil erosion is likely to occur; the effects of disturbing vegetation are analyzed in Section IV.B.6. Disturbance of vegetation alters the thermal balance, and those soils containing surplus ice may lose volume when there is thawing; subsidence, thermokarsting, and gullying follow. Removal of the surface organic mat exposes the mineral portion of the soils to the erosive forces. Wind and water will transport sediment from these soils, and this sediment may be deposited in sensitive areas. Excavation and removal activities likely would completely destroy the soils involved. In these instances, the impacts are local only and probably not widely distributed. In other instances with soils containing surplus ice, the impacts can be much broader. The dominantly ice-rich permafrost soils will warm and slump and release meltwater, which will pond. The ponded water will absorb more radiant energy and increase the area of warming soils. The process of warming, melting, and slumping can continue well beyond the area of initial disturbances and may take several years to stabilize, even if the soils are only lightly disturbed.

Oil spills also will impact soils only as the vegetation is altered. The oil alone would decrease vegetation growth, but oil spills themselves probably would leave the surface organic mat intact. Spill cleanup, however, is more likely to damage soils. Cleanups are not always well controlled; heavy traffic and digging are common, and the soils are damaged. Oil-spill cleanup mitigates impacts on soils only if cleanup methods and operations are very carefully controlled; cleanup activities should minimize any surface disturbance.

Conclusion: Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. Impacts to soils from management actions under Alternative A would involve either disturbance or destruction of relatively small areas. The duration of these impacts may be short term, ranging from several years if the vegetation is disturbed and up to many decades if the soils are destroyed. Relatively, the overall impact to soils in the planning area is expected to be just a few acres compared to a total of more than 4 million acres in the whole planning area.

Effectiveness of Stipulations: Stipulations beyond those required with current management could not reduce the impacts to soils (see Stipulation 71, which shall be complied with by all activities). Emphasis should be on maintaining the thermal properties of the existing vegetation and surface organic mat or substituting other thermal insulation.

2. Paleontological Resources: Paleontological resources (plant and animal fossils) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative A, there is one type of activity that has the potential for causing measurable impacts on paleontological resources—excavation and collection. Excavation and collection normally occurs during the summer and usually is the result of archaeological research (Sec. IV.B.12), although the process is sometimes associated with geologic fieldwork. Archaeologists and geologists are trained to properly care for paleontological resources. Most paleontological material is buried considerably deeper than cultural material and, therefore, not regularly encountered by chance. Some Pleistocene-age animal remains may be recovered in archaeological deposits, if the deposit is old enough. In such situations, the bones would represent subsistence use of the animal(s) by humans, and the faunal material would be considered part of the archaeological record as well as belong to the regional paleontological record.

The temporary summer field camps commonly associated with scientific or resource assessment work generally impact only relatively small areas. Therefore, such camps and the activities that are associated with them, such as aircraft use, on-the-ground survey/reconnaissance, hazardous- and solid-material removal and site remediation, and recreation, are not expected to have any significant effect on paleontological resources.

Conclusion: Under Alternative A, impacts to paleontological resources would result from management activities other than oil and gas exploration (except seismic activity) and development. These impacts can be satisfactorily addressed through the current assessment and decisionmaking process.

Effectiveness of Stipulations: Because Alternative A does not allow leasing, exploration (other than seismic) or development, the current EA review and clearance process and the "standard" stipulation (#79) attached to all Land Use Authorizations issued for the NPR-A, accompanied by irregular surveillance, generally are adequate to protect paleontological resources.

3. Water Resources: Ground-impacting-management actions within the planning area that may affect water resources under Alternative A include ground activities such as resource inventories, paleontological and cultural excavations, research and recreational camps, seismic surveys, and overland moves—all of which might occur during summer or early fall, except the latter two activities, which occur during the winter on snow-covered frozen tundra.

Seismic activities have been ongoing during most winters, even though there has been no current leasing since 1984. Seismic activities involve seasonal occupation and transport using sledge-drawn trailers (wanigans) at transitory locations, when snow cover is sufficient to cover the tundra and lakes and rivers are frozen (Appendix A).

Because little surface disturbances are expected under this alternative, there probably would be no significant effect on water resources above that indicated in the water-quality section (Sec. IV.A.4). However, there may be some sites that require remediation from earlier exploration or military activities. Temporary camps would be sited on existing pads or on well-drained soils on the inactive floodplain or uplands, sited back from the stream or lake shore and with minimal surface disturbance. Winter occupation or moves would use sledge-drawn trailers (wanigans) at transitory locations. All fuel, waste, and hazardous materials would be stored onsite according to ADEC guidelines and removed seasonally.

Small spills would be contained with bermed and lined storage areas, and there would be sufficient absorbents and petroleum containment and removal equipment onsite. No large spills are expected to occur under this alternative, because only small amounts of fuel would be stored onsite.

Conclusion: Impacts to water resources under Alternative A would be minimal and of short duration.

Effectiveness of Stipulations: Stipulations that are effective in protecting the water resources require camps, travel routes, and surface-disturbing activities to be located away from streams and lakes; restrictions on the amount of fuel that can be stored onsite; all fuel and waste material be hauled out annually; overland moves be conducted in the winter when the streams, lakes, and tundra are frozen and covered with snow; and travel routes be altered to avoid snow compaction and excessive freezedown, especially at stream and lake crossings.

4. Water Quality: Seismic trails would be the major affecting agent for water quality under Alternative A. Other ground-impacting-management actions within the planning area would not affect water quality.

Seismic operations would be allowed under Alternative A, starting in late fall, following freezing of the top foot of the active layer and buildup of snow cover. Seismic vehicles used would be a combination of tracked vehicles from small Nodwell 110's for surveyor travel to Caterpillar tractors for pulling seismic camp trains and possibly buggy style vehicles such as Rolligons and Deltas (Rice, 1997). With the exception of a new buggy design that may lessen the need to have a snowplow in the lead in deeper snow, most of the seismic vehicle in use are types that have been used in North Slope seismic operations for one to three decades.

Carefully regulated seismic operations conducted in the ANWR in 1984 to 1986 resulted in "medium-to-high impact" on 29 percent of the seismic trails (Raynolds and Felix, 1989). Greater damage occurred in vegetated river terraces, in more bumpy terrain (such as high-centered polygons or tussocks), and in areas with little snow cover. Wetter and more vegetated sites were less impacted. An example of a high-impact area found would be a swath denuded of vegetation 33 ft wide and up to 160 ft long. Recovery of damaged seismic tracks is at least a many-year process (Walker, 1996). Observations made 5 years after seismic operations in the ANWR found that thaw settlement had not yet stabilized (Felix et al., 1992), indicating a potential thermokarst erosion.

For Alternative A, seismic trails could extend over 2,500 mi of trackline (10 2-D surveys over 20 years). Based on the ANWR experience, 29 percent of seismic trails could have degraded cover, with potential for long-term thermokarst erosion. The snow cover in the NPR-A is thinner than in the ANWR, which could increase the frequency of disturbance of the vegetative cover. Total area covered by tracklines would be 10,000 acres. If it is assumed that 10 percent of an impacted seismic trail were damaged enough to result in potential thermokarst erosion, then about 300 acres of tundra [2,500 mi x 33 ft x 29% x 10%] could be subjected to thermokarst erosion. Thaw settlement also would affect long-term local hydrology, including downflow water quality, perhaps over twice this area, with the total area affected being 900 acres.

Thermokarst erosion can result in water features with high turbidity/suspended-sediment concentrations. To get high turbidity, the peat mat must be sufficiently eroded to expose underlying mineral soils. The mineral soils also must be fine grained. Measurements in a small stream near Barrow undergoing thermokarst erosion, and meeting such conditions, found ≤27 miligrams per liter (mg/l) suspended solids and ≤11 Jackson turbidity units (JTU) upstream of the erosional feature, 820 mg/l (610 JTU) at the erosional cut, and 160-280 mg/l (250-470 JTU) farther downstream (Barsdate and Prentki, 1973). Although the applicable State turbidity standards are defined in nephelometric turbidity units (NTU), inconvertible with JTU, the standard for secondary water recreation (e.g.; fishing) generally limits turbidity to a 20-percent increase from the natural level. Both the JTU turbidity and suspended-sediment concentrations increased much more than 20 percent, rather by an order of magnitude across the thermokarst feature. Thus, thermokarst erosion could cause the State turbidity standard to be exceeded within and downflow of thermokarst features.

Other ground-impacting management actions within the planning area would not affect water quality. Excavation and collection activities would be by hand shovel or trowel over several square feet, with replacement of the vegetative layer. These activities are required to protect streams and lakes from siltation and to avoid or minimize disturbance to vegetation. No fuel spills are anticipated under Alternative A, and stipulations in place require no storage in active lake floodplains and at least a 100-ft setback from any river, lake, or stream, with impermeable dikes around facilities over 660 gal. Black water and sludge are to be incinerated or removed from public lands to ADEC-approved waste-disposal facilities. Recreational activities permitted by BLM are required to follow the National Outdoor Leadership School's "Leave No Trace, Alaskan Tundra" program in regard to minimizing impacts to vegetation, waste water, human waste, and solid waste.

Conclusion: Long-term water quality over about a total of 900 acres would be affected by biannual 2-D seismic programs under Alternative A.

Effectiveness of Stipulations: Stipulation 20a could increase water quality effects. Stipulation 20a restricts seismic operations from deeply drifted snow areas where effects on vegetative cover and, thus, risk of thermokarst erosion and water-quality effects, would be minimized. This stipulation also restricts cutting or compaction of snow, which increases the likelihood that the seismic operators would have to use tracked rather than wheeled (buggy) vehicles, again increasing the likelihood of thermokarst erosion and water-quality effects. The Stipulation 20j requirement that average snow depth be 6 in prior to starting seismic operations is insufficient to mitigate damage to vegetative cover and, thus, protect water quality. Effective protection requires a minimum 10 in of snow cover (Walker, 1996).

5. Air Quality: There are no significant activities planned under Alternative A that would affect air quality within the planning area. Helicopter and light-plane use would have a transitory effect on local air quality; however, no long-term effect would be noted.

Conclusion: Air quality would not be affected by air-impacting actions within the planning area under Alternative A.

Effectiveness of Stipulations: There would be no stipulations for air quality for this alternative.

6. Vegetation: Ground-impacting-management actions within the planning area that may affect vegetation under Alternative A include: aerial surveys, paleontological and archaeological excavations, camps for research or recreation, overland moves, and seismic surveys. Most of these activities, except for overland moves, seismic surveys, and some aerial surveys, occur during June to September.

Most off-runway landings during management surveys would be by fixed-wing aircraft using skis or floats; fewer would be by wheeled aircraft. Only wheeled aircraft has the potential to affect vegetation. Most wheeled-aircraft landings would occur on sand or gravel bars or possibly on dry, gravelly ridges. These landings have a potential to cause minor, short-term damage to the scattered vegetation present on bars or ridges. Because there are too many unknowns associated with this, the minor impacts anticipated cannot be quantified.

Archaeological digs are most likely to occur on drier soils, where a sod layer has formed. In this case, the sod may be removed and replaced causing a temporary disturbance rather than vegetation destruction. However, the surface vegetation may be destroyed in some archaeological digs and in most or all paleontological digs. The cumulative extent of such activities is not expected to exceed 1 acre per year.

Camps can result in vegetation trampling due to foot traffic and tent placement and small spills of stove or generator fuel. This can result in temporary (1 to a few growing seasons) disturbance to vegetation. Most recreational camps are expected to occur on river bars, where vegetative cover is minimal. Large camps for research or resource inventory are likely to occur on existing gravel pads, which also have minimal vegetative cover. The total land surface affected by camps is not expected to exceed 10 acres per year and would be scattered over several sites, with most containing little or no vegetation.

Most overland moves through the planning area involve traffic between Deadhorse and Barrow. Moves would occur in winter only, when the ground is frozen and covered with snow. The impact to vegetation varies with vehicle type, vegetation type, and snow conditions. Low-ground-pressure wheeled vehicles have less impact than tracked vehicles or sleds on skids. Less impact usually would be expected in the wetter tundra where the effect, if any, may be the compression of snow and dead matter leaving "green trails" visible for one to a few growing seasons (Sec. IV.B.16, Recreation and Visual). However, if a tracked vehicle makes a tight turn or drops its blade too deeply through the snow, surface vegetation may be disrupted. If this occurs in wet tundra, thermokarsting can cause impacts greater than those commonly experienced in drier tundra. Travel over low shrubs could cause plants to be broken, and travel over tussocks sometimes results in their tops being scraped off. Thus, overland moves may vary from having no observable effects in some situations to damaging vegetation and melting permafrost to the extent that it may take years or even decades (Emers and Jorgenson, 1997; Jorgenson and Martin, 1997) to heal. A trail across the planning area would be about 100 mi in length. If the trail is 12 ft wide, the impact potentially could affect about 150 acres.

Seismic exploration causes the same types of impacts to vegetation as those described for overland moves. Under Alternative A, it is assumed there would be one crew active in the planning area in alternate winters, collecting about 250 line miles of 2-D seismic data. The exterior dimensions of each survey area are assumed to be about 600 mi^2 (384,000 acres) and the maximum area impacted by seismic lines to be 6,060 acres (250 mi x 200 ft wide). This figure is presented as a maximum, because not all of the area within a 200-ft wide line actually would be overrun by a vehicle. Trails also are made by camp-move vehicles, which traverse about the same distance as line miles of survey (Emers and Jorgenson, 1997). In addition, trails are made through the planning area while traveling to and from the survey area. A camp-move trail is about 12 ft wide, and it is assumed the camp train would involve two or three strings of trailers. These strings could use the same trail, but this would cause greater damage than to use separate trails. For this analysis, it is assumed that on average, 2.5 individual camp-train strings would use different trails to decrease overall damage and, thus, camp-move trails effectively would impact a path 30 ft wide. With 250 mi of trail within the survey area and an additional 106 mi entering and leaving the planning area, this would impact a total of 1,290 acres. Thus, the total area impacted by seismic surveys would be <7,350 acres every other year because, as stated above, not all the area within a seismic line would be affected.

Table IV.B.6-1
Proportion of Vegetation Impacts to each Land Cover Category

Land Cover Categories MAJOR and Minor	Percent of Impacts
WATER	
Ice	0.0
Clear Water	0.0
Turbid Water	0.0
AQUATIC	
Carex aquatilis	4.8
Arctophila fulva	0.5
FLOODED TUNDRA	
Low Centered Polygons	8.3
Nonpatterned	3.4
WET TUNDRA	6.4
MOIST TUNDRA	
Sedge/Grass Meadow	12.8
Tussock Tundra	37.0
Moss/Lichen	2.0
SHRUB	
Dwarf	19.7
Low	2.2
Tall	0.1
BARREN GROUND	
Sparsely Vegetated	0.6
Dunes/Dry Sand	0.9
Other	1.3

A study of tundra disturbance by winter seismic surveys on the eastern portion of Alaska's North Slope (Jorgenson, In press) indicated that 1 to 2 years after a survey, the disturbance level to the affected tundra under seismic lines was little to none for 11 percent of the area, low for 64 percent, medium for 23 percent, and high for 2 percent. After 8 to 9 years, recovery had reduced the disturbance level to little or none on 97 percent of the affected area, and no areas of medium or high disturbance remained. The tundra under camp-move trails did not recover as rapidly. One to two years after the survey, the disturbance level to the affected tundra under camp-move trails was little to none for 22 percent of the area, low for 52 percent, medium for 24 percent, and high for 2 percent. After 8 to 9 years, recovery had reduced the disturbance level to little or none on only 85 percent, with low on 10 percent, medium on 4 percent, and high on 1 percent. Applying these data to the above scenario for the planning area suggests that about 1,850 acres would experience medium to high disturbance every other year and, after 9 years of recovery, that level of disturbance still would be evident on 65 acres.

It is assumed that impacts to vegetation from overland moves and seismic surveys would occur to different land-cover classes in proportion to their occurrence in the planning area (Table III.B.2-1), with the exception of the three water classes. Thus, these impacts, whether or not quantified as to area involved, would occur among the land-cover classes as presented in Table IV.B.6-1.

Conclusion: Impacts to vegetation from management actions under Alternative A would involve either disturbance or destruction. The duration of these impacts would be short term, ranging up to 5 months, and complete recovery could vary from 1 year to decades. The overall impact to the vegetation communities of the 4.6-million-acre planning area would be minor to negligible.

Effectiveness of Stipulations: Alternative A reflects current management, and the above analysis was done assuming that current stipulations would continue to be implemented.

7. Fish:

Fish inhabiting the arctic region are described in Section III.B.2. As noted therein, arctic fish differ substantially from their counterparts inhabiting warmer regions. In addition to their many differences, arctic fish also have developed unique life history, behavioral, physiological, and population characteristics that enable them to exist under extremely harsh and fluctuating environmental conditions of both daily and seasonal occurrence. Occasionally, these conditions cause high mortalities, especially to the more sensitive lifestages (eggs and juveniles). Because of this, arctic fish populations have adapted to withstand at least short-term perturbations and fluctuations in the environment, whether natural or human caused.

a. Effects of Disturbance:

Actions associated with Alternative A that could cause disturbance to fish include the establishment of large work camps at pre-existing airstrips; small scientific excavations for archaeological, paleontological, geologic, and soils-related information; seismic surveys; the sport harvest of fish by workers; and actions associated with fuel spills at fuel-storage sites. The establishment of work camps, scientific excavations, and the sport harvest of fish by workers are not expected to have a measurable adverse effect on arctic fish populations. Seismic surveys and fuel spills at fuel-storage sites may adversely affect arctic fish.

Seismic surveys use acoustical energy pulses to locate subsurface geological structures that might contain oil or gas. On land, these energy pulses are generated by special vibrator equipment mounted on trailers and towed on sleds. Seismic impulses generated in this way have a much smaller effect on fish than high explosives, which formerly were used to generate the necessary seismic impulses. Because of this, the relatively small number of seismic surveys expected, and the low density of arctic fish in most of the planning area, seismic surveys are expected to have no perceptible effect on individual arctic fish. The only exception would be if a seismic survey were conducted above overwintering habitat. Because arctic fish are concentrated in these areas all winter and would be relatively close to the vibrator equipment operating above them, it is likely that they would be adversely affected. Likely effects would include avoidance behavior and short-term added stress, possibly resulting in the death of some of the more sensitive lifestages (e.g., juveniles). However, the effects of seismic surveys on most overwintering fish are expected to be short term and sublethal. For this reason and because most seismic surveys are not likely to occur above overwintering habitat (>95% of the planning area is not overwintering habitat), seismic surveys are not expected to have a measurable effect on arctic fish populations.

b. Effects of Spills:

Under Alternative A, small fuel spills at fuel- storage sites could occur. The effects of fuel spills on fish are expected to be similar to those of crude-oil spills, although much reduced in duration due to evaporation. The effects of oil spills on fish have been discussed in previous Beaufort Sea EIS's (e.g., USDOI, MMS, 1996a), which are herein incorporated by reference and summarized. Oil spills have been observed to have a range of effects on fish (see Rice, 1981; Starr et al., 1981; Hamilton et al., 1979; Malins, 1977, for a more detailed discussion). The specific effect depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). If lethal concentrations are encountered, or sublethal concentrations are encountered over a long-enough period, fish mortality is likely to occur. However, mortality due to a petroleum-related spill is seldom observed outside the laboratory environment. Most acute-toxicity values (96-hour lethal concentration for 50% of test organisms [LC_{50}]) for fish generally are on the order of 1 to 10 parts per million (ppm). Concentrations observed under the oil slick of former oil spills at sea have been less than the acute values for fish and plankton. For example, concentrations observed 0.5 to 1.0 meters (m) beneath a slick from the *Tsesis* spill (Kineman et al., 1980) ranged from 50 to 60 parts per billion. Extensive sampling following the *Exxon Valdez* oil spill (about 260,000 bbl in size) also revealed that hydrocarbon levels were well below those known to be toxic or to cause sublethal effects in plankton (Neff, 1991). The low concentration of hydrocarbons in the water column following even a large oil spill at sea appears to be the primary reason for the lack of lethal effects on fish and plankton.

The fresh waterbodies in the planning area are substantially smaller in size than the marine environment, where the effects of former oil spills have been observed. However, the size of fuel spills associated with Alternative A also is likely to be much smaller. Hence, the likelihood of lethal effects is expected to be generally similar to that observed for oil spills at sea (i.e., very low). Additionally, most fuel spills are expected to occur on the pad where they are stored and would not come in contact with fish habitat. Sublethal effects are more likely to occur and include changes in growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources; and consumption of contaminated prey. Some fish and food resources in the immediate area of a fuel spill could be lethally or sublethally affected, particularly if the spill occurred where and when fish were migrating, in overwintering areas during winter, or in small waterbodies having restricted water exchange. If a fuel spill of sufficient size occurred in a small waterbody containing fish with restricted water exchange, lethal and sublethal effects would be expected on most of the fish and food resources in that waterbody; and recovery may be >5 years. However, due to the small size of the fuel spills anticipated, the low diversity and abundance of fish in most of the planning area, and the unlikelihood of spills blocking fish migrations occurring in overwintering areas or small waterbodies (containing many fish) with restricted water exchange, fuel spills associated with Alternative A are expected to lethally or sublethally affect a small number of the fish in the planning area over the life of the IAP. Recovery from each spill affecting fish is expected within 3 years.

Conclusion: Fuel spills are expected to lethally or sublethally affect a small number of the fish in the planning area over the life of the IAP. Recovery from each spill affecting fish is expected within 3 years.

Effectiveness of Stipulations: Stipulations 15, 16, and 20 are the most likely to have a beneficial effect on arctic fish. Others that may benefit arctic fish include Stipulations 5, 9, 11, and 12. With these stipulations in place, there is an increased probability that (1) spawning and overwintering fish would be unaffected by activities associated with Alternative A, (2) fish passage and streamflows would be maintained, and (3) the effects of accidental fuel spills would be minimized. To the degree they are implemented, these stipulations are expected to benefit arctic fish populations. However, because there is relatively little activity associated with Alternative A that may affect arctic fish, their absence is not expected to measurably increase adverse effects on arctic fish populations.

8. Birds: This section discusses potentially adverse effects of ground- impacting-management actions on nonendangered birds within the planning area under Alternative A. The primary effects on birds exposed to such activities would be altered distribution, abundance and/or behavior resulting from disturbance during the breeding, molting, or migration periods; alteration of habitats; and effects resulting from pollution of the environment by refined-oil products. Nearly all of the approximately 75 species of regularly occurring birds are migrants, seasonally occupying a variety of wetland, tundra, riverine, and marine habitats in or adjacent to the northeastern NPR-A. Principal bird groups considered include loons and waterfowl, shorebirds, raptors, passerines, and seabirds.

a. Effects of Disturbance: Noise from human activities, as well as visual presence of humans and/or equipment, may disturb birds during any phase of the annual cycle. Birds may be disturbed easily during sensitive periods as when attending a nest, broodrearing young, or in a flightless molt condition. Potentially disturbing activities (Table IV.A.1a-1) include aircraft traffic, winter ground transport, seismic surveys, ground-based resource surveys, activities associated with camps, waste removal, and recreational traffic. Attraction of predators to sites of activity may increase predation on birds.

(1) Effects from Ground-Based Activities: It is assumed that ground transport associated with private, industry, or agency activities (Table IV.A.1.a-1) will occur during winter months (December-April), when nearly all birds are absent from the region. If the 20 to 100 trips annually between Prudhoe Bay or Oliktok Point and Barrow take place over offshore ice, there would be no effect on birds. Although there is little direct evidence from winter studies, the effect of occasional (e.g., 1 trip/week) overland traffic along the coast is expected to temporarily displace ptarmigan, gyrfalcons, and snowy owls present in the area for <1 day and up to 700 ft (213 m) from the route (Grubb, et al., 1992; Murphy and Anderson, 1993; Skagen, Knight, and Orians, 1991; Stalmaster and Newman, 1978); if traffic is more routine (e.g., 1 trip/1.5 days), the two raptors may vacate an area of up to 0.6 mi (1 kilometer [km]) from the route. These effects are expected to last the winter-transport season, with recovery to original distribution and abundance following cessation of the activity in late spring.

Although this alternative includes no oil and gas exploration, seismic surveys may occur during winter months (December-April), when nearly all birds are absent from the region. Seismic-survey trains (2-D = 10 vehicles), with crews of 60 traversing gridlines 5 to 10 mi apart, temporarily (3-7 days) may displace small numbers of ptarmigan, gyrfalcons, and snowy owls from within 700 ft (213 m) to 0.6 mi (1 km) of the local activity area around each 5- to 10-mi segment of up to 250 mi (402 km) of survey gridlines covering an approximately 600-mi^2 ($1{,}554\text{-km}^2$) area. Because both the areas of potential disturbance and birds are dispersed over a large area, there is not expected to be a significant population effect.

Large summer camps (~15 persons) potentially located at Inigok Creek airstrip, Umiat, Lonely DEW-Line site (Fig. III.C.7-3), and possibly the abandoned Ikpikpuk well site (Fig. III.A.1.f-1), may result in a local-disturbance area as much as 700 ft (213 m) to 0.6 mi (1 km) from each camp (35-776 acres; 0.14-3.14 km^2) for the 6-week duration of operation. Humans on foot and noise-generating activities are expected to cause responses ranging from moving to the safety of a nearby lake to departure from the area for several hours (Burgess and Ritchie, 1989). Nest attempts and success are expected to decline in any such area, but the effect probably would vary considerably depending on the availability of appropriate habitat for each species comprising the local bird community (there may be little undisturbed habitat in the immediate vicinity of these occupied or formerly occupied sites), the intensity of disturbance factors, and the sensitivity of each species to disturbance and their tendency to habituate to particular factors.

No known high-density areas for species recorded on the breeding pair surveys (King, 1997, pers. comm.) coincide with any of these sites except for tundra swan, northern pintail, and oldsquaw in the Lonely area (Figs. III.B.4-6, -12, -13), and possibly postbreeding concentrations of shorebirds near the Ikpikpuk site (Fig. III.B.4-17). Density values and waterfowl behavior observations (Murphy and Anderson, 1993) suggest that breeding efforts of a maximum of 3 swans, 11 oldsquaw, and 20 pintail could be disturbed if the area were entirely suitable habitat populated by typical densities of these species. Each of the identified sites has medium- and low-density areas of virtually all species recorded on breeding-pair surveys and, presumably, various shorebirds, passerines, and raptors. Studies in the Prudhoe Bay area indicate that numerical response to development may range from a substantial decrease to a substantial increase in nesting density (TERA, 1993 Fig. 16). Local populations of those species adversely affected are expected to experience only minor declines in breeding success in summers when the camps are occupied, and the lost productivity may not be detectable above the natural fluctuations of the population and survey methods/data available. Likewise, broodrearing or molting birds probably would be displaced from the vicinity of these camps, but the small area and numbers involved is expected to result in negligible loss of foraging habitat for these local groups of individuals and negligible declines in survival and recruitment. Activities at small resource-survey camps along the Colville and Ikpikpuk rivers potentially may disturb nesting raptors and passerines for short periods (3-5 days) during a 3-week interval, but effect of such short-term presence on productivity is likely to be negligible. Paleontological survey camps, occupied for up to 6 weeks in the central planning area, may disrupt some nesting attempts by waterfowl, shorebirds, and/or passerines but are expected to cause only minor local loss of productivity.

Disturbance during hazardous-waste and solid-material removal and remediation activity involving operation of heavy equipment for up to 3 to 4 weeks, or cleanup of fuel spills reaching off-site areas during the breeding season, temporarily may displace a small number of nesting, broodrearing or molting birds from the immediate area, but effects are not expected to extend beyond 700 ft to 0.6 mi. Either activity may cause local disruption of some breeding attempts or foraging activities, but the losses probably would not be detectable above the natural fluctuations of the population and survey methods/data available.

Boat travel from June to September for recreation, hunting, or transport to resource-survey camps on the Colville River, and potentially the Ikpikpuk and Kogosukruk rivers, could expose a substantial proportion of the Alaskan arctic peregrine falcon population, as well as gyrfalcons and rough-legged hawks, to human presence. The current float-trip traffic (up to 14 parties ≤5 persons each season or about 1/week passing peregrine eyries—9 of these occurring above Umiat where peregrine density is lower than below; Fig IV.B.4-18) has not prevented the regional peregrine population from increasing. There is no indication that this level of activity is adversely affecting the other two species.

The attraction of bird predators (glaucous gull, common raven, arctic fox, grizzly bear) to uncontained refuse is well known. It is not certain if predator populations with access to refuse are higher than they would be in its absence. Nor is it certain in most instances what effect predation by these species has on overall reproductive success and local population trends, although some studies have demonstrated a high correlation between presence or absence of predators and reproductive success. Fox and gull predation on island-nesting species or those that are colonial has been implicated in nest losses ranging from substantial to total failure (e.g., snow goose, Burgess and Rose, 1994; Johnson and Noel, 1996, common eider, Quinlan and Lehnhausen, 1982). Several studies have correlated nest success with fox-predation pressure (e.g., brant and shorebirds, Underhill et al., 1993). The various camps supporting proposed summer activities in the planning area could attract potential predators, but most will be short-term with small numbers of people present. Seismic trains are expected to be restricted from discarding refuse by stipulation and would be active in winter, when primarily arctic foxes are present. The few large summer camps will be in place for sufficient periods to attract all four species but are not likely to cause other than local concentration of predators affecting local breeding success. The extent of any effect is not known but could specifically involve tundra swan, northern pintail, oldsquaw, and probably other waterfowl species present at lower densities in the Lonely area, and these species or any of several shorebird and passerine species there and at other proposed sites. Overall productivity and recruitment lost from the local area may not be detectable above the natural fluctuations of the population and survey methods/data available.

(2) **Effects from Aircraft Operations.** Both fixed-wing aircraft and helicopters are used for summer-season (June-September) aerial surveys, support of ground-based surveys and camps, and support of recreational activities. Primarily fixed-wing aircraft would be used for support of seismic surveys.

Establishment and maintenance of large summer camps (see above) requires aircraft support several times per week as well as flights for transport to worksites and for aerial wildlife and other surveys. If aircraft supplying or operating out of these camps overfly high bird-concentration areas routinely, an adverse noise/visual aspect and probably other waterfowl species that are present at lower densities could be introduced to the environment, causing abandonment of nesting efforts or lower survival of young in extreme cases, avoidance of certain areas of favorable habitat for future nesting attempts, or excessive activity/weight loss in the case of molting geese. The Ikpikpuk wellsite, between southwest Teshekpuk Lake and the Ikpikpuk River, is located west of concentrations of five species recorded on surveys of the Arctic Coastal Plain near the lake—yellow-billed loon, Pacific loon, greater white-fronted goose, oldsquaw, and king eider areas east of the lake (Figs. III.B.4-3, -4, -9, -13, -14). High-concentration areas of white-fronted goose, northern pintail (Fig. III.B.4-12), and oldsquaw are recorded at the Lonely site. In addition, the second most heavily used goose broodrearing lake (Fig. III.B.4-7) and many of the lakes most heavily used by molting geese occur along eastern approaches to Lonely (Fig. III.B.4-2), and concentrations of the red-throated loon, tundra swan, and Sabine's gull (Figs. III.B.4-5, -6, -19) also occur in the vicinity of this site. Few concentrations of coastal plain survey species other than scaup (Fig. III.B.4-15) are recorded in the immediate vicinity of the Inigok Creek site, and the survey area does not include Umiat. Any of the sites may have local concentrations or presence of one or more duck, shorebird, and/or passerine species, and pairs of glaucous and Sabine's gulls, arctic tern, jaegers, or raptors may be nesting in the vicinity.

Wildlife aerial surveys based at camps are expected to involve daily flights for 2 weeks, primarily in late June and early July in several wildlife areas, although caribou tagging may continue through July. Aerial surveys for eiders in early to mid-June and waterfowl-breeding pairs in late June-early July cover much of the Arctic Coastal Plain each year, and 200 lakes north and east of Teshekpuk Lake are censused for molting geese in mid- to late July. Such flights have a considerable potential for disturbance, because they require low-altitude operation over areas occupied by birds in sensitive phases of the annual cycle (nesting, broodrearing, molting). Occasional BLM resource aerial surveys will occur June to August. Use of aircraft to establish or move small recreational or agency camps and carry out aerial surveys could be additive to routine, large camp-supply operations. Any surveys for hazardous- and solid-waste sites may concentrate in the Teshekpuk Lake and Colville River Special Areas, where waterfowl and raptor concentrations could experience additional stress from aircraft overflights. An estimated 18 flights/week may result from combined activities in the planning area; more importantly, at least 7/week are expected to occur in the Goose Molting Habitat LUEA. Peak flight frequency is associated with periods of aerial survey activity in late June and late July.

The overall impact of aircraft would depend on the character of the operations—type of aircraft, flight frequency, altitudes, routes used (lateral distance), season of operation—and the sensitivity of the population segment exposed to characteristics potentially causing disturbance. Studies in the vicinity of Teshekpuk Lake (Derksen et al., 1992) found that molting brant, a species particularly sensitive to disturbance, responding to helicopter altitude and lateral distance during experimental overflights were significantly more disturbed by those below 3,511 ft (1,070 m) within 2.5 mi (4.0 km) than above this altitude, as indicated by the duration of escape behavior in response to a disturbing activity. Response to aircraft was most severe at intermediate altitudes (300-760 m). Beyond a lateral distance of 2.5 mi (4 km), disturbance response declined, irrespective of altitude. Disturbed birds were found to move away from an area at five times the rate of undisturbed birds, suggesting that disturbance could elevate energy expense and may adversely influence the use of preferred habitat by brant. Also, they could be subject to greater predation if they are forced to move between lakes (Derksen, Weller, and Eldridge, 1979), and initial settling. Routine disturbance could cause brant to bypass preferred lakes during the initial settling phase following arrival (Derksen, et al., 1992). Molting brant showed no significant habituation to aircraft (Jenson, 1990). A study of staging brant at Izembek Lagoon (Ward and Stehn, 1989) indicates a greater response to helicopters than fixed-wing aircraft under most circumstances. Displacement of molting birds from preferred foraging habitat suggests two energetic costs as yet not directly measured: (1) added cost of behavior to escape the disturbance area, and (2) the greater cost of accumulating energy required for fether growth and fat deposits for use during migration, in potentially inferior foraging habitat. Brant weight loss in the Teshekpuk Lake area was modeled under various disturbance intensities (frequency, altitude, aircraft type) from aircraft flying between abandoned airstrips at Lonely and Kogru sites. Direct flights between the two potentially disturbed about 48 percent of the molting brant population (8,284). With 10 helicopter overflights/day at 1,001ft (305 m) altitude, the model predicted light weight loss in about 88 percent of these individuals; aircraft at higher altitudes caused less disturbance, and somewhat lower percentages of the geese lost weight. The model does not predict a weight threshold below which brant could experience significantly reduced survival, successful migration to their staging area, or recruitment. In the planning area, estimated flight frequency associated with anticipated reasonably foreseeable actions that involve aircraft operations (Table IV.A.1.a-1) mostly to and from large camps plus occasional survey surveys and daily wildlife survey flights over specific areas generally would average between 1.1 and 2.6/day. Based on the results of the Teshekpuk Lake brant study, this level of activity probably would cause only light weight loss in this species in a few local areas. The ultimate result of such an effect in terms of reproductive success or survival of young or adults has not been determined for any species; any lost productivity or recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available. At the Lonely site where access requires aircraft to cross the Goose Molting Habitat LUEA or approach from the sea, any adverse effects of the combination of camp and aircraft activities on productivity and recruitment also may not be detectable above the natural fluctuations of the population and survey methods/data available.

Although bird species vary in sensitivity to disturbance, any breeding or postbreeding birds exposed to routine aircraft disturbance could be displaced from local habitats and/or subject to increased energy demands. For example, helicopter disturbance of one gyrfalcon pair did not cause nest abandonment or reduced productivity, but the pair did not occupy that site the following year (Platt, 1977).

b. Effects of Spills: Birds experiencing moderate to heavy contact of refined-oil products (primarily fuels and lubricants) are not expected to survive. However, because such spills (estimated average volume 0.7 bbl) are likely to occur on pads (or ice roads in winter) where they can be contained and removed, significant exposure of birds is not expected to occur. If fuel reaches a small lake where, for example, relatively low populations of molting geese occur, losses of tens of individuals are possible. A larger fuel release entering a goose-molting lake may affect several hundred individuals; in either case, recovery to the original population status may not be detectable above the natural fluctuations of the population and survey methods/data available.

Summary: Under Alternative A, disturbance associated with large camp activities and aircraft operations are expected to cause the most substantial impacts on bird populations, although the actual effects are difficult to quantify. Overland winter ground transport is expected to cause ptarmigan, gyrfalcons, and/or snowy owls to temporarily (<1 day) vacate the area up to 700 ft (213 m) from the route with occasional traffic (1 trip/week), and up to 0.6 mi (1 km) with routine traffic (5 trips/week); reoccupation of the areas is expected following cessation of the activity in late spring. Seismic surveys in winter are expected to have a similar effect along each 5 to 10 mi segment for up to 250 mi (402 km) of survey gridline covering approximately 600 mi^2 (1,554 km^2). Large summer camps (>15 persons) and paleontological survey camps may produce a local disturbance area of 700 ft to 0.6 mi for the 6 weeks of operation. Local populations of nesting, broodrearing, or molting species adversely affected by human presence and activities at these camps are expected to experience minor declines in breeding success or displacement to undisturbed habitats when camps are occupied, and any lost productivity or recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available. Small survey camps along Colville and Ikpikpuk rivers may disturb raptors and passerines for 3 to 5 days, but effects are expected to be negligible. Hazardous-waste removal and remediation is expected to have similar effects and recovery. Boat travel on the Colville River, currently about one party/week, has not prevented the regional peregrine falcon population from increasing; proposed resource and monitoring human use on the Ikpikpuk and Colville rivers (3 weeks) is not expected to alter this trend. Proposed camps in the planning area could attract predators but are not expected to cause other than local concentrations affecting local breeding success, and lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available. Aircraft operations supporting several summer activities, including establishment and operation of camps and aerial surveys, results in an estimated flight frequency averaging 1.1 to 2.6/day; 1 flight/day may occur in the Goose Molting Habitat LUEA. Helicopters are most disturbing to brant, causing escape responses, movement

BLANK PAGE

out of foraging areas, and weight loss. A simulation model of molting brant predicted light weight loss with 10 overflights/day; brant exposed to fewer overflights proposed here are not likely to exceed this effect, although a relationship of weight loss to survival, successful migration, or recruitment has not been determined; thus, potential losses may not be detectable above the natural fluctuations of the population and survey methods/data available. Other molting or broodrearing species individuals less sensitive than brant would not be expected to exceed the effect predicted for brant. However, at the Lonely site, effects of the combination of camp and aircraft activities could be substantial. Losses of tens of molting geese are likely if a fuel spill reaches a small lake occupied by relatively few individuals and losses on the order of hundreds from contact with a large molting flock; lost productivity and/or recruitment in these cases may not be detectable above the natural fluctuations of the population and survey methods/data available.

Conclusion: Under Alternative A, most disturbance effects associated with ground transport and seismic surveys in winter, moderate flight frequency supporting large and small camps and aerial surveys, moderate increases of boat traffic on the Colville River, air transport of recreational parties, and spill-cleanup activities in summer, are expected to be localized, to within 700 ft to 0.6 mi of the disturbing activity, and temporary, ranging from brief (<1 day) in the case of response to a few aircraft flights or presence of ground or boat activity to several months for extended ground-transport operations. More intense activity, such as routine overflights of goose-molting lakes, the combination of large camp activity and associated aircraft operations, substantially increased river-boat traffic, or fuel spills entering lakes with large molting goose populations, is expected to result in more substantial losses, but recovery of lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available.

Effectiveness of Stipulations: Subject to several exemptions noted in Section IV.C.7, the proposed stipulations are expected to have the following mitigating effects.

Disturbance of birds from ground transport and other activities would be mitigated and essential habitat protected, by: (14; 20b-d, g-m) offsetting ice-road location annually, and minimizing and seasonally restricting vehicle use to minimize vegetation-damaging and erosion-causing activities, and taking recommended precautions in the Goose Molting and Colville River Raptor, Passerine, and Moose LUEA's (loons, waterfowl, shorebirds raptors, passerines affected); (17) not removing water from lakes in the Goose Molting Habitat if it would adversely affect lakeshore goose-feeding habitat (loons, waterfowl, shorebirds). Aircraft disturbance of birds would be mitigated by: (55) seasonal restriction of BLM-authorized fixed-wing aircraft flight frequency in the Goose Molting Habitat LUEA (loons, waterfowl, shorebirds), and (56, 57, 58) maintenance of seasonal minimum flight altitudes and lateral distance over the Teshekpuk Lake and Colville LUEA's (loons, waterfowl, shorebirds, raptors, passerines).

Potentially adverse situations involving hazardous materials and wastewater would be mitigated by: (5, 8) immediate cleanup of fuel spills and other hazardous materials using procedures approved by USEPA, ADEC, and OSHA, and materials stored at all fueling and maintenance areas; (9, 11, 12) storing fuels in lined/diked areas at least 500 ft (152 m) from lakes and streams, not storing fuels on lake or river ice, and not refueling equipment within 500 ft of lakes or streams (loons, waterfowl, shorebirds, passerines).

Other potentially adverse situations would be mitigated by: (13c) not disposing of domestic wastewater into freshwater; (1, 75) taking precautions to avoid attracting wildlife (predators) to refuse, and prohibiting the feeding of birds (most birds), and (67) requiring all visitors to adhere to the applicable stipulations.

These stipulations would minimize disturbance from most factors, prevent fuel spilled on pads/roads from reaching surrounding habitats, and help prevent pollution and degradation of critical wildlife habitats.

9. Mammals:

a. Terrestrial Mammals:

Among the terrestrial mammal populations that could be affected by ground-impacting-management actions under Alternative A are caribou of the Teshekpuk Lake Herd (TLH) and the Central Arctic Herd (CAH). Caribou of the Western Arctic Herd (WAH) are not expected to be significantly affected, because their calving range is located far to the west of the planning area (Fig. III.B.9.a.-1). Some caribou of the WAH may be temporarily exposed to helicopter traffic and other human activities associated with resource inventories and seismic operations, but such exposure is not expected to have any effects on the population. Moose, muskoxen, grizzly bears, wolves, wolverines, and arctic foxes may be locally affected by activities in the planning area.

(1) Effects of Disturbance: Activities that may affect terrestrial mammals include aerial surveys (including those for wildlife) and ground activities such as resource inventories, paleontological excavations, research camps, recreational camps (hunting and river floating), seismic operations, and overland moves. Overland moves and seismic activities occur during the winter on frozen tundra, ice roads, or stable shorefast ice. The other activities occur from summer to early fall (June-September). The primary potential causes of disturbance of terrestrial mammals are helicopter traffic (1-2 round trips/day for 3-6 weeks/survey party), fixed-wing aircraft traffic (2/week/party), and humans on foot. These activities are expected to cause short-term (few minutes to <1 hour) displacements and/or harassments of terrestrial mammals. Recreational camps in some cases may attract bears and result in the shooting of bears that learn to associate humans with food sources. Such losses by themselves are expected to be minor or insignificant to the bear population but will contribute to cumulative adverse effects.

Small rodents (such as lemmings and voles) and their predators (such as short-tailed weasels) are expected to be affected locally (direct mortality and loss of habitat of individuals or small groups of lemmings and voles) at paleontological excavations and by overland moves. However, these losses are expected to be insignificant to populations on the Arctic Slope of Alaska.

(2) Effects of Spills: Very small fuel spills (probably <1 bbl) may occur in association with resource-inventory surveys, recreational activities, and overland moves. These spills are likely to involve aviation fuel and other light-fraction hydrocarbon fuels that would evaporate and disperse rapidly in the environment with only a local effect on vegetation. Fuel spills are required to be cleaned up immediately, if possible, under current BLM stipulations. Such events are not expected to have any significant effects on terrestrial mammals in the planning area.

Conclusion: The effects of Alternative A on terrestrial mammals are expected to be local, within about 1 to 2 km of activities, and short term, with no significant adverse effects on mammal populations (except the arctic fox, which may increase in abundance near permanent camp facilities).

Effectiveness of Stipulations: Stipulations described in Section II.C.7 regarding solid- and liquid-waste disposal, fuel handling, and spill cleanup are expected to reduce the potential effects of spills and human refuse on grizzly bears and other terrestrial mammals. Stipulations on overland moves and seismic work are expected to minimize alteration of terrestrial mammal habitats. The stipulation on aircraft to maintain 1,000 ft above ground level (AGL) (except for takeoffs and landings) over caribou winter ranges from October through May 15, and 2,000 ft AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, is expected to minimize disturbance of caribou.

b. Marine Mammals: Ground-impacting-management actions along the coast within the planning area that may affect nonendangered marine mammals under Alternative A include aerial surveys (including surveys of wildlife); ground activities such as resource inventories, paleontological excavations, and research and recreational camps (hunting and river floating), seismic exploration, and overland moves. Overland moves and seismic operations occur during the winter on stable sea ice or frozen tundra. The other activities take place in summer and early fall (June-September). The primary potential causes of disturbance of marine mammals are helicopter traffic (1-2 round trips/day for 3-6 weeks/survey party), fixed-wing aircraft traffic (2/week/party), and humans on foot. These activities, if they occur along the coast of the planning area, may cause short-term (<1 hour) displacements or harassments of hauled-out seals and polar bears.

It is assumed that geophysical surveys would use 60 persons and would collect 5 to 10 line miles of 2-D seismic data/day and would be conducted entirely in winter (early December-mid-April) using ice roads. Under Alternative A, seismic surveys conducted near the coast could expose a few denning polar bears to seismic-activity noise and associated disturbances. This activity could result in the displacement of a few maternal polar bears and their cubs, leading to the abandonment of the den site and possible loss of a small number of cubs. Few polar bears are expected to be affected, however, because of the low number of recorded maternal den sites in and adjacent to the planning area (Fig. III.B.5.b). Seismic surveys also would be prohibited near known polar bear den sites in the planning area (see Effectiveness of Stipulations, below).

Onshore seismic activity is not expected to have any effects on other marine mammals. Ringed seals den during the winter; however, denning ringed seals are not expected to be exposed to the noise and activity associated with onshore seismic operations, because their denning habitat is located in the floating-fast ice zone generally some distance offshore.

Overland moves typically occur each winter, travel from Prudhoe Bay or Oliktok Point to Barrow, follow a route offshore over stable sea ice, and include 20 to 100 trains of 1 to 6 vehicles and attached sleds. These moves could be a disturbance to denning ringed seals, if the routes cross floating fast-ice areas, and may temporarily displace seals within a short distance of the traffic route. Polar bears also may be temporarily disturbed within about 1 mi of this traffic.

Recreational camps in some cases may attract bears, and this could result in the shooting of bears that learn to associate humans with food sources. Such losses by themselves are expected to be minor or insignificant to the bear population but will contribute to cumulative adverse effects.

Very small fuel spills (probably <1 bbl) are expected to occur in association with resource inventories and surveys, recreational activities, and overland moves. These spills are likely to involve aviation fuel and other light-fraction hydrocarbon fuels that would evaporate and disperse rapidly with only local effect on vegetation. Fuel spills are required to be cleaned up immediately, if possible, under current BLM stipulations. Such events are not expected to have any significant effects on marine mammals in the planning area.

Conclusion: The effects of Alternative A on marine mammals, particularly polar bears and seals, along the coast of the planning area are expected to be local and to occur within about 1 mi of resource-inventory-survey activities, survey and recreational camps, and overland moves. These effects are expected to be short term, with no significant adverse effects on the populations as a whole.

Effectiveness of Stipulations: The stipulation to prohibit overland moves and seismic activity near known polar bear dens is expected to reduce disturbance of female bears and their cubs that may be denning in the planning area. However, because the locations of dens vary from year to year, it is possible that a few dens could be disturbed by overland moves and seismic operations that occur near the coast.

The stipulation on aircraft to maintain a 1,000-ft AGL (except for takeoffs and landings) may reduce any disturbance of spotted seals hauled out along the Colville River delta or ringed or bearded seals hauled out on the fast-ice along the coast.

10. Endangered and Threatened Species:

a. Consultation Assumptions: The endangered bowhead whale and the threatened spectacled and Steller's eiders may occur seasonally in or adjacent to the planning area and may be exposed to activities associated with the management plan. Such activities, particularly oil and gas exploration and development/production activities and aircraft traffic associated with wildlife studies, may result in noise and disturbance, altered habitat, and spilled oil or other contaminants and could adversely affect the behavior, distribution, and abundance of individuals or populations occurring in or adjacent to the planning area.

Sections 4(d) and 9 of the Endangered Species Act (ESA), as amended, prohibit taking of listed species of fish and wildlife without a special exemption. "Take" is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. "Harass" is further defined as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behaviors which include, but are not limited to, breeding, feeding, or sheltering. "Harm" is further defined as an act which may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

In accordance with the ESA, Section 7, regulations governing interagency cooperation, BLM notified the Fish and Wildlife Service (FWS) by letter dated May 6, 1997, of the listed and proposed species to be included in a Biological Evaluation for Section 7 consultation for the IAP/EIS. The National Marine Fisheries Service (NMFS) was requested by letter dated May 6, 1997, to notify BLM of any listed or proposed species or critical habitat that may be present in or affected by oil and gas exploration activities in the proposed lease-sale area. The NMFS responded by letters dated May 23, June 10, and June 26, 1997, confirming the endangered bowhead whale as the species to be included in the evaluation for the planning area and referenced additional species that could be affected along marine-transportation routes in the Gulf of Alaska/U.S. West Coast. As discussed below, potential effects on a number of species along the marine-transportation routes in the Gulf of Alaska/U.S. West Coast were analyzed in previous biological evaluations and are incorporated herein by reference. The potential effects on species of endangered and threatened salmon, endangered cutthroat trout, endangered and threatened steelhead Evolutionary Significant Units (ESU's), steelhead ESU's that are proposed to be listed, and steelhead ESU's that are listed as candidate species are discussed in Section IV.C.10 (Alternative B). The FWS responded on July 2, 1997, confirming the threatened spectacled eiders and Steller's eiders as the appropriate species to be discussed in the evaluation and referenced additional species that could be affected along marine-transportation routes in the Gulf of Alaska/U.S. West Coast.

Analysis of oil-spill risk on species along marine-transportation routes in the Gulf of Alaska/U.S West Coast, particularly the southern sea otter and marbled murrelet, can be found in the Cook Inlet Planning Area Oil and Gas Lease Sale 149 Final EIS (FEIS) (USDOI, MMS, Alaska OCS Region, 1996b), which is summarized and incorporated herein by reference. The FEIS discusses potential effects of an oil spill on these species as a result of tankers transporting oil from the Cook Inlet lease-sale area to California ports. Potential effects include impairment of their insulative capabilities, resulting in hypothermia; inflammation/lesion of sensitive tissues

310

following oil contact; tissue or organ damage from ingested oil; and emphysema from inhaled vapors. Potential indirect effects from an oil spill include a reduction in available food resources due to mortality or unpalatable prey organisms. Mortality of southern sea otters resulting from any spill of oil (estimated probability of occurrence is 6% in the potentially affected area) tankered from the Cook Inlet area to southern California is expected to be moderate (an estimated 23 individuals) with an estimated 1-year-recovery time (<1 generation), although conditions prevailing at the time of a spill could cause much greater mortality to occur. Mortality of marbled murrelets resulting from any spill of oil (estimated probability of occurrence is 6% in the potentially affected area) tankered from the Cook Inlet area to northern California is expected to be high (estimated 30-144 individuals, 2-9% of the California population), with an estimated 3- to 15-year (2-8 generations) recovery time.

The analysis of oil-spill risk on species along transportation routes to ports in the Far East, including the threatened Aleutian Canada goose, threatened Steller's eider, endangered short-tailed albatross, threatened Steller sea lion, and several species of endangered whales, can be found in the Beaufort Sea Planning Area Oil and Gas Lease Sale 144 FEIS (USDOI, MMS, 1996a), which is summarized and incorporated here by reference. In Alaskan waters, the probable oil-tanker route lies seaward of the 200-mi Economic-Exclusion-Zone boundary except in the northcentral Gulf of Alaska, where it exits Prince William Sound. Oil spilled along most of this route would tend to be moved parallel to the Alaska Peninsula and Aleutian Islands, particularly by the Alaskan Stream, rather than toward the coast, where vulnerable populations might be contacted. Oil spilled from a tanker soon after exiting Prince William Sound could contact the Kodiak and Alaska Peninsula areas. Aleutian Canada geese, which nest in the Aleutian and Semidi Islands, do not appear to spend significant time in marine habitats during the breeding period, suggesting little risk of oiling from a tanker spill. However, occasional sightings of this goose in the Kodiak area during the spring-migration period, and the presence of Steller's eiders during the winter season in coastal areas from the eastern Aleutian Islands to Cook Inlet, suggest that small portions of these populations could be vulnerable to a spill in the northern Gulf of Alaska during the spring and winter, respectively. Because short-tailed albatrosses are rare anywhere outside the breeding area south of Japan, it is unlikely that significant numbers would be contacted by a spill along the tanker route. Rookeries and haulouts of Steller sea lions are scattered from Prince William Sound to the western Aleutians. Sea lion pups are more vulnerable than juveniles and adults but remain at the rookery and thus are not likely to be oiled directly. Several species of endangered whales also occur in waters adjacent to the route, but they are not likely to experience any mortality from exposure to spilled oil. It is anticipated that most of the oil produced as a result of lease sales in Alaska will be shipped to southern ports rather than to Far East ports. Overall, for the reasons listed above, the effects on the listed species are expected to be minimal.

The following analysis of potential effects was extracted from pertinent sections of the Biological Evaluation for Endangered and Threatened Species with Respect to the Proposed Northeast NPR-A Lease Sale (included as Appendix F of this EIS).

b. Ground-Impacting Activities: Ground-impacting-management actions within the planning area that may affect bowhead whales and spectacled and Steller's eiders under Alternative A include aerial surveys (including that of wildlife) and ground activities such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall. Overland moves and seismic activities, which occur during the winter on ice roads or frozen tundra, are discussed but are unlikely to have an effect on these species. A more detailed discussion of all of the actions is found in Section II. No oil and gas lease sale would occur under Alternative A.

(1) Effects on the Bowhead Whale: Bowhead whales may be present in the area offshore of the planning area primarily from August through October during their fall migration from Canadian waters back to wintering areas in the Bering Sea. Under Alternative A, bowhead whales are not likely to be affected by activities associated with the management plan.

(2) Effects on the Spectacled and Steller's Eiders: Spectacled and Steller's eiders may be adversely affected by activities associated with the management plan for the planning area. Spectacled eiders are widely distributed throughout the coastal plain portion of the planning area and are essentially absent from the area from October to May. Most nesting on the Arctic Slope occurs along this coastline, particularly west from the Sagavanirktok River. Larned and Balogh (1994) observed spectacled eiders throughout the survey area from the mouth of the Canning River to 50 km south of Point Lay, but they were most abundant within 60 km of the coast between Barrow and Wainwright and in the Teshekpuk Lake area. The highest densities of nesting spectacled eiders in the planning area occur in the Spectacled Eider Nesting Concentration LUEA (spectacled eider LUEA) to the north, west, and east of Teshekpuk Lake (Fig. II.B.3). Postbreeding male spectacled eiders leave the planning area by late June. Females are present in the breeding area from May to September. Females with young typically are found offshore later when the ice usually is farther from the coast (Petersen, 1997, pers. comm.). Steller's eiders are relatively sparsely distributed throughout the planning area and are essentially absent from the area from late October to May. Males leave the nesting areas in late June to early July. Females with broods are present in the breeding area from early June to late August or early September. A discussion of potential effects on spectacled and Steller's eiders follows.

(a) Effects of Noise and Disturbance: Man made noise and activities, as well as human presence, may result in disturbance of spectacled and Steller's eiders in the planning area. Noise-producing activities, including aircraft traffic and hazardous- and solid-material removal and remediation, are the activities most likely to affect spectacled and Steller's eiders. Overland traffic and seismic surveys also are discussed but are not likely to affect eiders.

1) Effects from Aircraft Activities: Aircraft will be used to support activities associated with the management plan. Both fixed-wing aircraft and helicopters would be used to transport people, supplies, and equipment for fieldwork and to fly aerial surveys. Light helicopters are commonly used, and medium helicopters and fixed-wing planes are occasionally used. Helicopters normally fly low and slow, whereas fixed-wing aircraft usually fly higher and faster. Almost all aircraft activity would be in the summer. Aircraft likely will fly over nearly all of the planning area, but many flights apparently will be over waterfowl habitat areas in the lake areas to the north, west, and east of Teshekpuk Lake. Some flights, such as point-to-point flights and other aerial surveys, will be flown occasionally. Aerial wildlife surveys, some of which may be low-level flights, are conducted during a 14-day period from late June into early July over caribou and waterfowl areas (Table II.D.3). Helicopters may be used during some of the studies, such as collaring caribou in the lake areas to the north and east of Teshekpuk Lake. In addition, more intense surveys will be flown for hazardous and solid wastes in the Teshekpuk Lake Special Area.

Summertime aircraft flights over onshore areas of the planning area, especially to the north, west, and east of Teshekpuk Lake, may affect nesting females and their broods. The lake areas to the north, west, and east of Teshekpuk Lake are very important areas for waterfowl during the summer months. The highest densities of spectacled eiders in the planning area may use some of these lakes and other habitat in the area for breeding, nesting, and rearing their young. Some Steller's eiders also may use some of these lakes and other habitat in the area and may be affected by these activities. These are areas where helicopters will be used during some of the studies, such as collaring caribou. Both helicopters and fixed-wing aircraft may be used in this sensitive area for aerial wildlife surveys for other survey activities.

Under Alternative A, a substantial portion of spectacled eider LUEA to the north, west, and east of Teshekpuk Lake may be affected by aircraft activities. Balogh (1997) indicated that fixed-wing aircraft flown at an altitude of 150 ft often cause spectacled eiders to flush, although helicopters flown at similar altitudes around Prudhoe Bay do not cause them to flush. Reactions of eiders to aircraft are not well understood. Nests are regularly located in a wetland within 1 km of the Deadhorse Airport (TERA, 1995), and a nest was located <250 m from the Deadhorse runway (Martin, 1997), indicating that some individuals are tolerant of aircraft activity in the vicinity of nests. Behavioral reactions of prenesting birds to aircraft overflights may not be representative of behavior of incubating or brood-tending birds. It is possible that some eiders may be disturbed by these activities and may experience temporary, nonlethal, effects probably lasting less than an hour. It is possible that some displacement of nesting eiders along flight-survey routes near airstrips could occur as a result of the numerous aircraft overflights and landings in the sensitive areas. Relatively few nest sites are expected to be affected, because spectacled eider nest sites are scattered at relatively low density over much of the northern portion of the planning area and at even lower densities in the rest of the planning area. Steller's eiders in other portions of the planning area are less likely to be affected by aircraft flights, because fewer flights are likely to be conducted in those areas, and Steller's eiders are present at low densities. Disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

2) Effects from Hazardous- and Solid-Material Removal and Remediation: There are three phases to addressing hazardous and solid materials in the planning area—site characterization, removal, and remediation. Site characterization involves small helicopters and fixed-wing aircraft conducting fairly intensive surveys in the Teshekpuk Lake Special Area and other areas. The effects of aircraft disturbance on eiders was discussed previously. Removal and remediation involves activity on the ground at the location. Drill rigs, hydropunches, or backhoes are used to determine and assess the nature and extent of contamination of the site. These activities may continue for as long as 3 to 4 weeks. Because these activities are conducted during the summer months, they could cause disturbance to eiders that are breeding, nesting, or rearing young in the area and may displace a few eiders. Disturbance of eiders due to cleanup activities is likely to be limited to within a few kilometers of the activities but could continue for as long as 4 weeks.

3) Effects from Overland Moves: The BLM issues permits to authorize overland moves.

Overland moves are typically from Prudhoe Bay or Oliktok Point and typically are conducted during the winter between December and April. There should be no effects on spectacled and Steller's eiders as a result of overland moves.

4) Effects from Seismic Activities: Some 1-D and 2-D seismic exploration will occur in alternate winter seasons under Alternative A even though oil and gas leasing would not occur. No 3-D seismic is anticipated. No effects on spectacled and Steller's eiders are expected to occur as a result of seismic surveys, because seismic activities would occur during the winter.

Summary: Under Alternative A, bowhead whales are not likely to be affected by activities associated with the management plan. Spectacled and Steller's eiders are not expected to be affected by seismic surveys or overland moves, both of which will be conducted during the winter. However, some eiders may be affected by activities associated with hazardous and solid material removal and remediation. These activities may continue for as long as 4 weeks. Also, summertime aircraft flights over these sensitive areas may affect nesting females and their broods. Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake may be overflown by aircraft (both helicopters and fixed-wing) on a regular basis during the summer months and may experience temporary, nonlethal effects, probably lasting less than an hour. Due to the relatively low density of eiders in the area, substantial disturbance is not expected to occur; and any disturbance is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

Conclusion: Bowhead whales are not likely to be affected by activities associated with the management plan. Overall, the effects on spectacled and Steller's eiders exposed to noise-producing activities are expected to be minimal. Eiders breeding, nesting, or rearing young in coastal habitats or other areas within the planning area may be overflown by support aircraft and may experience temporary, nonlethal effects, probably lasting less than an hour. Eiders affected by activities associated with hazardous- and solid-material removal and remediation may be affected for as long as 4 weeks. Due to the relatively low density of eiders in the planning area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

Effectiveness of Stipulations: No stipulations are anticipated to protect bowhead whales. Section II.C.7 contains a list of stipulations proposed by BLM to protect various waterfowl species from various activities in the planning area. Stipulations included under several categories, such as solid- and liquid-waste handling, hazardous-material disposal and cleanup, overland moves and seismic work, ground transportation, orientation program, aircraft traffic, and other activities should provide adequate protection to eiders from some activities. However, noise and disturbance from aircraft traffic associated with nonoil and gas activities, such as aerial wildlife surveys and other aerial surveys conducted in the lake areas to the north, west, and east of Teshekpuk Lake, have the potential to affect breeding and nesting eiders, because several of the aircraft stipulations pertaining to flight-timing restrictions apply only to oil and gas activities and/or do not apply to Alternative A. Therefore, the stipulations associated with flight-timing restrictions of aircraft probably are not adequate to protect spectacled eiders and Steller's eiders from aircraft disturbance associated with aerial wildlife surveys and other surveys conducted in the lake areas to the north, west, and east of Teshekpuk Lake. Steller's eiders in other portions of the planning area are less likely to be affected by aircraft flights, because fewer flights are likely to be conducted in those areas. Disturbance of some individuals over the life of the project is expected to be unavoidable.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: For Alternative A, a 2-D seismic-survey party of approximately 50 persons would work for 4½ winter months, generating 50 jobs for 4½ months. Employment in the recreation field would be generated by 14 float-trip parties of 1-week's duration each per year (Table II.H.3.b), which is equal to one person for 4 months each year.

b. Oil and Gas Exploration and Development Activities: For Alternative A, there would be no economic effects.

Conclusion: For activities other than oil and gas exploration and development for Alternative A, generating approximately 50 jobs for 4½ months associated with seismic surveys and recreation-field employment equivalent to one person working 4 months per year. For oil and gas exploration and development activities for Alternative A, there would be no economic effects.

Effectiveness of Stipulations: Stipulations do not change potential economic effects.

12. Cultural Resources: Cultural resources (the physical remains resulting from the activities of historic or prehistoric humans) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative A, there are three types of activity that have the potential for causing measurable impacts on cultural resources—overland moves, seismic data-gathering, and excavation and collection. Because the first two activities normally occur between November and May when the ground is covered with snow and deeply frozen, any subsurface (buried) cultural material usually is safe from disturbance. In locations where cultural material is exposed on the surface of the ground beneath the snow, some minor impact may occur and some material may be slightly displaced from its context, if equipment traverses or operates directly over the cultural material. At greatest risk are cultural resources that are composed of aboveground structures such as cabins, sod houses, caribou corrals, cairns, drying racks, kayak templates, etc. Aboveground structures receive little natural protection from snow or frozen ground and indeed often are hidden from sight by snowfall, making them difficult for equipment operators to see (see Nuiqsut Scoping Meeting comments by L. Lampe, April 10, 1997).

Excavation and collection normally occurs during the summer and usually is the result of archaeological research, although the process is sometimes associated with geologic fieldwork. When an archaeological site is excavated, it is destroyed. Therefore, archaeological excavation and collection is the ultimate destructive impact on cultural resources, although the process is the most common mitigative technique when cultural resources are threatened and avoidance is not an option. Archaeological excavation usually is conducted as either a means of obtaining information for scientific purposes or for documenting the information in a site prior to its destruction by development activities or natural forces.

The temporary summer field camps commonly associated with scientific or resource assessment work generally impact only a relatively small area. Therefore, such camps and the activities that are associated with them, such as aircraft use, on-the-ground survey/reconnaissance, hazardous- and solid-material removal and site remediation, and recreation, are not expected to have any significant effect on cultural resources.

Conclusion: Under Alternative A, impacts to cultural resources would result from management activities other than oil and gas exploration (except seismic activity) and development. These impacts can be satisfactorily addressed through the current assessment and decisionmaking process.

Effectiveness of Stipulations: Because Alternative A does not allow leasing, exploration (other than seismic), or development, the current Environmental Assessment (EA) review and clearance process and the "standard" stipulation (#79) attached to all Land Use Authorizations issued for the NPR-A, accompanied by irregular surveillance, generally is adequate to protect cultural resources. In addition, Sections 106 and 110 of the National Historic Preservation Act, E.O. 11593, consultation with the State Historic Preservation Officer (SHPO), and input from the NSB History, Language, and Culture Commission provide guidance for assessment and protection of cultural resources within the NPR-A.

13. Subsistence-Harvest Patterns: This discussion is concerned with subsistence resources and subsistence-harvest patterns of Native communities adjacent to the NPR-A that could be impacted by ground-management actions from the IAP/EIS. These communities are Barrow, Atqasuk, and Nuiqsut. Under Alternative A, no oil and gas leasing would occur, and the current BLM management regime would continue.

The primary subsistence resources and aspects of subsistence-harvest patterns covered in this analysis are (1) a heavy reliance on caribou and fish (and bowhead whales in Barrow and Nuiqsut) in the annual average subsistence harvest for all three villages; (2) the subsistence-harvest areas for Barrow, Atqasuk, and Nuiqsut overlap for many species harvested by these communities; (3) subsistence hunting and fishing are cultural values that are central to the Inupiat lifeway and culture; and (4) the need to guarantee healthy populations of these resources for local subsistence needs. For a more in-depth discussion of the parameters for subsistence-harvest patterns impact analysis, see the discussion for Alternative B (Sec. IV.C.13).

a. Ground-Impacting Activities:

(1) Effects of Disturbance: Ground-impacting-management actions within the planning area that may affect subsistence harvests under Alternative A include aerial surveys (including that of wildlife) and ground activities such as seismic surveys, resources inventories, paleontological and cultural excavations, research and recreational camps and overland moves—all of which occur during summer-early fall (June-September), except for overland moves and seismic activity, which occur during winter. The primary potential causes of disturbance are helicopter traffic, fixed-wing aircraft traffic, and humans on foot. Hazardous- and solid-waste removal and remediation would continue to occur at abandoned

USGS/Husky exploration drill sites. As these are normal activities under the existing BLM management regime, little net change is expected in disturbance effects to subsistence resources and the communities nearby the planning area.

(2) Effects of Spills: Because there would be no oil and gas leasing under Alternative A, only potential oil spills from fuel storage at construction sites and camps could occur, but the size of such spills is likely to be small (a few barrels) and areal contamination small. Cleanup activity is not likely to cause great disturbance to normal subsistence-harvest activities or the surrounding environment.

b. Effects on Subsistence Species: Effects from seismic surveys on most overwintering fish are expected to be short term and sublethal and have no measurable effect on arctic fish populations. Disturbance effects to bird populations from ground transport, seismic surveys, and aircraft activity are expected to be localized from 100 yards to 0.6 mi form the disturbing activity and temporary (<1 day for aircraft overflights to several months for extended ground-transport activities). Recovery of lost bird productivity and recruitment is expected to require one breeding season or less. Disturbance effects on terrestrial mammals—caribou, muskoxen, moose, grizzly bears, wolves, wolverines, and arctic foxes—are expected to be local (within about 1-2 km of activities) and local, with no adverse effects on mammal populations. Similar effects are anticipated for marine mammals. Impacts from ground-disturbance activities and oil spills on local subsistence harvests of fish, birds, terrestrial mammals (especially caribou), and marine mammals are expected to be negligible.

c. Effects on Communities: Effects to the communities of Barrow, Atqasuk, and Nuiqsut from impacts to subsistence resources and subsistence-harvest patterns from ground-disturbance activities and oil spills are expected to be negligible.

Summary: Because there would be no oil and gas leasing and no net change in BLM management practices in the NPR-A under Alternative A, impacts from ground-disturbance activities and oil spills on the subsistence resources and the subsistence-harvest patterns of the communities of Barrow, Atqasuk, and Nuiqsut are expected to be negligible.

Conclusion: Impacts on the subsistence resources and the subsistence-harvest patterns of Barrow, Atqasuk, and Nuiqsut from this no-leasing alternative are expected to be negligible.

Effectiveness of Stipulations: Stipulations for general disturbance, general damage, and the chasing of wildlife as well as the wildlife stipulations for polar bears, caribou, and birds appear to afford effective subsistence-resource protection for a no-action alternative. Other stipulations articulate a minimum protection against impeding subsistence pursuits as set down in ANILCA (P.L. 96-487).

14. Sociocultural Systems:

This discussion is concerned with those communities that could be impacted by ground-management actions from the IAP/EIS. These communities are Barrow, Atqasuk, and Nuiqsut. Under Alternative A, no oil and gas leasing would occur, and the current BLM management regime would continue.

The primary aspects of the sociocultural systems that could be impacted are (1) social organization and (2) cultural values, as described in Section III.C.4. For a more in-depth discussion of the parameters for sociocultural-effects analysis, see the discussion for Alternative B (Sec. IV.C.14).

a. Ground-Impacting Activities:

(1) Effects of Disturbance: Ground-impacting-management actions within the planning area that may affect sociocultural systems under Alternative A include aerial surveys (including that of wildlife) and ground activities such as seismic surveys, resources inventories, paleontological and cultural excavations, research and recreational camps and overland moves—all of which occur during summer-early fall (June-September), except for overland moves and seismic activity, which occur during the winter. The primary potential causes of disturbance are helicopter traffic, fixed-wing aircraft traffic, and humans on foot.

Hazardous- and solid-waste removal and remediation would continue to occur at abandoned USGS/Husky exploration drill sites. As these are normal activities under the existing BLM management regime, little net change is expected in disturbance effects to subsistence resources and the communities nearby the planning area.

(2) Effects of Spills: Because there would be no oil and gas leasing under Alternative A, only potential oil spills from fuel storage at construction sites and camps could occur, but the size of such spills is likely to be small (a few barrels) and areal contamination small. Cleanup activity is not likely to cause great disturbance to normal subsistence-harvest activities or the surrounding environment.

b. Population and Employment: With no oil and gas leasing under this alternative, NSB and community population and employment would not be affected and would be expected to grow at normal rates without any additional industry-related employment or population increases.

c. Subsistence-Harvest Patterns: With no oil and gas leasing under this alternative, impacts on subsistence resources would be negligible, and subsistence harvests would continue without industry-related disturbances. The lack of seismic activity could potentially reduce disturbance to overwintering caribou. Short-term, local effects on caribou, muskoxen, moose, grizzly bears, wolves, wolverines, and arctic foxes within 1 to 2 km of resource-inventory survey activities, survey and recreational camps, and overland moves are expected, but they would have no significant adverse effects on these populations. Similar effects from the same sources would be anticipated for polar bears and seals. Disturbance to eiders and other waterfowl from hazardous- and solid-waste removal and remediation activities and survey flights of fixed-wing aircraft and helicopters could have short-term, localized effects.

d. Effects on Barrow, Atqasuk, and Nuiqsut: Impacts from ground-disturbance activities, oil spills, changes in population and employment, and changes to subsistence-harvest patterns on the sociocultural systems of the communities of Barrow, Atqasuk, and Nuiqsut are expected to be negligible, because there would be no oil and gas leasing and no net change in BLM management practices in the NPR-A under Alternative A.

Conclusion: Due to no increase in effects to the sociocultural systems of Barrow, Atqasuk, and Nuiqsut from this no-action alternative, impacts are expected to be negligible.

Effectiveness of Stipulations: Stipulations for general disturbance, general damage, and the chasing of wildlife as well as the wildlife stipulations for polar bears, caribou, and birds appear to afford effective subsistence-resource protection for a no-action alternative. Other stipulations articulate a minimum protection against impeding subsistence pursuits as set down in ANILCA (P.L. 96-487).

15. Coastal Zone Management: Under the Alaska Coastal Management Program (ACMP), coastal district enforceable policies and State standards for development and natural resource use and conservation within the coastal zone are identified. All activities either occurring within the coastal zone or that may reasonably be expected to affect coastal resources and uses must be conducted in a manner consistent with the ACMP. While Federal lands are defined as being outside the coastal zone, Federal activities and federally permitted activities are to be reviewed for consistency with coastal management programs.

Ground-impacting-management actions under Alternative A are associated with (1) aircraft use to transport personnel, supplies, and equipment for fieldwork and to fly aerial surveys; (2) excavation and collection of archaeological, paleontological, geological, and soil samples; (3) ground activities associated with aircraft use and camps for field survey and recreational activities; (4) hazardous- and solid-material removal and remediation; (5) overland moves of equipment and supplies and seismic activities; and (6) recreational activities. Management actions do not include any oil and gas lease sales or other special-use designations. There are no significant activities planned under Alternative A that would result in conflict with existing coastal management policies within the planning area.

Although the NPR-A lies entirely within the boundaries of the NSB, Federal lands are not a part of the coastal zone and, therefore, not a part of the coastal district. Four North Slope villages (Barrow, Wainwright, Nuiqsut, and Atqasuk) are located within the NPR-A, with Nuiqsut being located within the planning area. Two other North Slope villages are located near the NPR-A (Point Lay and Anaktuvuk Pass), and their residents make extensive use of NPR-A land and resources. The enforceable policies of the NSBCMP have been incorporated within the zoning ordinance in Section 19.70.050. The NSB's zoning ordinance is enforceable within the Borough boundaries and out to 3 mi offshore in State waters and inland to approximately 25 mi and beyond along the full length of all major river corridors. In areas subject to exclusive Federal jurisdiction, all uses and activities that affect the coastal area must be consistent to the maximum extent practicable with the program. Therefore, those ground-impacting-management actions affecting subsistence and recreational uses and activities may apply.

Subsistence uses of the coastal resources in the NPR-A have been and will continue to be of the highest priority of the NSB Inupiat, given cultural and historic patterns of existence within NPR-A lands. Activities associated with Alternative A that may adversely affect subsistence activities, including hunting and fishing and resources as arctic fish, migrating birds, caribou, moose, and other fur-bearing animals, cultural and archeological resources, water quality, soils and vegetation, and recreation uses, are analyzed in Sections IV.B.1-14 and 16. Because there would be no oil and gas leasing and no net change in BLM management practices in the NPR-A under Alternative A, impacts from ground-disturbance activities associated with ground transport and seismic surveys in winter, effects of camp activities and aerial surveys, and small spill cleanup are expected to be temporary and minimal to negligible.

At the present time, seismic activities, if conducted as a stand-alone activity and not in conjunction with an exploration or development plan, do not require a separate consistency review under the ACMP and are covered under the State's General Concurrence "B list" of categorically approved activities.

Conclusion: Because leasing, exploration (except for seismic activities), or development activities are not allowed under Alternative A, there are no ground-impacting-management actions within the planning area that require coastal consistency reviews by the State.

Effectiveness of Stipulations: Under Alternative A, current BLM management practices, enforcement of stipulations (Sec. II.C.7) applicable to activities other than oil and gas, including water- resource protection and extraction, handling of solid and liquid wastes and disposals, general environmental and wildlife resource and subsistence protections stipulations, and land use authorizations issued in the planning area provide adequate protection to surface resources.

16. Recreation and Visual Resources: Under this alternative, most impacts to recreation and visual resources would be a result of on-the-ground management activities such as archeological collection efforts, field camps, survey work, and overland moves. Between June and September, three camp, survey, or collection efforts are anticipated at any one time. In winter months, several overland moves may occur during a single season.

Temporary structures (e.g., sleds, tents), vehicles (e.g., rolligons, tractors), noise from generators, aircraft, human presence, and associated activity all would have some minimal short-term impact on scenic quality, solitude, naturalness, or primitive/unconfined recreation. These adverse, short-term impacts would be confined primarily to the activity site viewshed (i.e., approximately ½ mi in any direction from the site) and are expected to affect no more than approximately 1,500 acres at a time.

A longer lasting impact would be "green trails" resulting from overland moves. Green trails are created by vehicles compacting snow and dead vegetative matter that, in turn, results in the greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails do not necessarily develop over the entire route of an overland move but when they do, they can be very detectable from the air for 2 to 5 years and, in some cases, longer. They usually are difficult to recognize from the ground. Another impact along these trails that has occurred in the past is vegetation actually being damaged or broken or the tops of tussocks being scraped off. Current operating procedures make this an infrequent problem but one that can occur in conjunction with green trails (Sec. IV.B.6). Because overland moves are a relative constant year to year and generally follow the same route(s), approximately 100 mi of intermittent green trail (attributable to overland moves) will be visible from the air during any one summer season.

Although no oil and gas development would occur under current management, seismic-survey work would continue. This work would occur in winter using all-terrain ground vehicles supported by light aircraft. Seismic crews are housed in mobile camps consisting of a train of trailer sleds pulled by tractors. These moving camps, associated noise (e.g., vehicles, aircraft), and activities would result in a short-term, adverse impact on scenic quality and a loss of solitude and naturalness. These impacts would be confined primarily to the activity-site viewshed, or approximately ½ mi in any direction. Assuming one seismic operation per season, seismic operations are expected to affect no more than approximately 500 acres at a time.

A longer lasting impact would be green trails resulting from seismic-survey operations. Unlike overland moves, seismic operations do not follow the same routes every year, and the number of miles of survey line run can vary greatly from year to year. In some years, no surveys would occur. As with green trails created by overland moves, these trails do not necessarily develop over the entire survey route and are visible for about 2 to 5 years and sometimes longer. Because of the many variables involved, it is difficult to make a reliable estimate as to the number of miles of green trail that would be visible during any one summer season as a result of seismic operations. However, given no more than one seismic operation a year, the number of miles of intermittent green trails visible from the air during any one summer season (from seismic operations) is estimated to be several hundred miles.

Impacts to Wild and Scenic River Values: Under Alternative A, outstandingly remarkable river values along the Colville would not receive any special protection under the Wild and Scenic Rivers Act (WSRA). However, under this alternative, no development is anticipated along the Colville River. Therefore, no impacts to outstandingly remarkable river values are expected.

Conclusion: Impacts to recreation and visual resources from activities other than oil and gas would be minimal and short term, affecting about 1,500 acres. Impacts from ongoing oil and gas activities (seismic surveys) also would be short term, affecting about 500 acres. Several hundred miles of green trails from overland moves and seismic surveys also would be visible during summer months.

Effectiveness of Stipulations: No Visual Management Classes are currently established. However, no permanent development is likely to occur under this alternative. Furthermore, current management practices and stipulations developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, and seismic operations are adequate to protect visual/recreation values.

C. ALTERNATIVE B: Alternative B would include BLM's management actions described for Alternative A and a proposal for making about 2 million acres of the Northeast NPR-A Planning Area available to oil and gas leasing. This alternative emphasizes protection of the area's resources by excluding oil and gas leasing in all the LUEA's defined in Section II except the Kuukpik Corporation Entitlement LUEA; leasing in this LUEA will be postponed until the corporation's entitlement has been satisfied. The status of the LUEA's for oil and gas leasing under Alternative B is shown in Table IV.C-1. Seismic activities would be permitted throughout the planning area. Applicable stipulations identified in Section II will be applied to this alternative. In addition, the alternative includes (1) recommending the Colville River be included as a "wild" river in the Wild and Scenic River System, (2) proposing a Bird Conservation Area that would incorporate part of the Colville River valley, (3) urging the creation of a Special Area designated by the Secretary of the Interior along the Ikpikpuk River to protect paleontological resources, and (4) recommending the addition of the Pik Dunes LUEA to the Teshekpuk Lake Special Area.

The types of activities that might impact the resources include those noted for Alternative A and those additional activities associated with oil and gas exploration and development. The level of activities other than oil and gas exploration and development would be similar to or slightly greater for Alternative B than for Alternative A (Table IV.A.1.a-1). The economically recoverable oil resources for the first oil and gas lease sale in the proposed lease-sale area are estimated to range from 65 to 350 MMbbl (Table IV.A.1.b-4). The activities associated with this resource estimate include drilling exploration (1-4) and delineation (0-6) wells and, depending on the economic viability of any discovery or discoveries, constructing 0 to 2 production pads, drilling 0 to 83 production and service wells, and constructing 0 to 75 mi of pipeline (Table IV.A.1.b-5). Pipelines would be permitted to cross all but the Potential Colville Wild and Scenic River LUEA. If the area available for oil and gas leasing under Alternative B results in multiple sales, 90 to 500 MMbbl of oil are estimated to be recovered (Table IV.A.1.b-6). The types of activities associated with multiple sales would be similar to those that might occur as the result of the first sale; the level of activities for multiple sales is shown in Table IV.A.1.b-7.

1. Soils: The types of activities that may affect soils under Alternative B include those analyzed under Alternative A and those resulting from oil and gas exploration and development.

a. Activities Other than Oil and Gas Exploration and Development: The effects of management actions described under Alternative B are similar to Alternative A, except there may be an increase in excavations of up to 2 acres per year (Sec. IV.C.6).

b. Oil and Gas Exploration and Development Activities: Those parts of the planning area subject to

Table IV.C-1
Land Use Emphasis Areas Status for Oil and Gas Leasing Under Alternative B[1]

Land Use Emphasis Area	Fig. No. II.B.	Oil and Gas Leasing Status
Teshekpuk Lake Watershed	1	Unavailable
Goose Molting Habitat	2	Unavailable
Spectacled Eider Nesting Concentrations	3	Unavailable
Teshekpuk Lake Caribou Habitat	4	Unavailable
Fish Habitat	5	Unavailable
Colville River Raptor, Passerine, and Moose Area	6	Unavailable
Umiat Recreation Site	8	Unavailable
Scenic Areas	9	Unavailable
Pik Dunes	10	Unavailable
Ikpikpuk Paleontological Sites	11	Unavailable
Kuukpik Corporation Entitlement	13	Leasing deferred pending completion of Kuukpik Corporation conveyance
Potential Colville Wild and Scenic River	14	Unavailable

[1] Section II.

these activities will have additional impacts on the soils. Sacrificing soils usually is part of development. Soils are destroyed through burial or truncation. Embankments such as work pads, camp pads, and roads made from sand, gravel, or rock fragments completely cover the natural soils. Digging, scraping, and excavation destroy the pedogenic horizons. Off-pad traffic (including foot traffic) and other surface-disturbing activities damage the vegetative cover and surface organic mat. Just as under Alternative A, the exposed mineral portion of the soils will erode. These activities also alter the thermal balance, and the risk of thermokarsting increases. Thermokarsts, gullies, and sediment impact other resources and land uses. Examples are difficult surface travel and access across gullies and thermokarsts. The amount of soil erosion increases with the amount of surface disturbance. Perhaps the most effective mitigation is to keep the areas of surface disturbance (i.e., alteration of the vegetative cover or damage to the surface organic mat) as small as possible. The amount of soil loss, based on the estimated areal extent of vegetation destruction, should be similar to that discussed under vegetation (Sec. IV.C.6).

Impacts to soils from spills and spill cleanup are based on the impacts to vegetation (Sec IV.C.6).

Conclusion—First Sale: Areas of impacts and losses of soils from all activities are similar to those areas discussed under vegetation (Sec. IV.C.6).

Multiple Sales: Additional lease sales under Alternative B would result in additional exploration and development activities. The area of impacted soils is closely related to that of the disturbed vegetation (see Vegetation, Sec. IV.C.6, for acreage details). However, recovery of soils is much slower than recovery of vegetation—it may take centuries. Soil-forming processes are very slow at these low temperatures.

Conclusion—Multiple Sales: Areas of impacts and losses of soils from all activities in multiple sales are similar to those areas discussed under vegetation (Sec. IV.C.6).

Effectiveness of Stipulations: There are no stipulations beyond those in Section II.C.7 that could reduce the impacts to soils.

2. Paleontological Resources:

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Paleontological resources (plant and animal fossils) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative B, the management-action impacts generally are the same as under Alternative A, except the intensity of the actions may increase due to potential oil and gas exploration.

(2) Oil and Gas Exploration and Development Activities: Paleontological resources are not ubiquitous in the planning area as are wildlife and habitat, and their locations are much less predictable. As a result, it is quite possible that no oil and gas exploration or development activities would impact a paleontological resources locale.

(a) Effects of Disturbance from Exploration: Under Alternative B, the level of activity in the planning area would increase. However, because most of the activity would occur during the winter months, the potential for impact to paleontological resources is extremely low.

Drilling 10 exploration/delineation wells is anticipated under Alternative B. Due to the limited availability of drill rigs, no more than two wells are expected to be drilled at one time. Drilling the 10 wells probably would occur over the span of several winter seasons, and drill pads, camp pads, roads, and airstrips made of ice and snow would be used. Because no permanent pads, roads, or airstrips would be constructed and, therefore, no significant disturbance of the ground would occur, buried paleontological resources would not be impacted. The only significant subsurface disturbance that would occur as a result of the actual drilling would be the drill hole itself. Drilling could impact significant accessible paleontological material, but the likelihood is minuscule.

(b) Effects of Exploration Spills: Sixty-five to eighty percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. Therefore, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions, where cleanup is less invasive than in a summertime terrestrial spill. In any case, paleontological resources usually are so deeply buried that they would not be affected by either a spill or spill cleanup.

(c) Effects of Disturbance from Development: The construction of two production pads (connected by a road), one airstrip, and 75 mi of pipeline is anticipated under Alternative B. Surface disturbance resulting from this work would impact approximately 100 acres, but there would be little subsurface impact associated with these activities. Additional disturbance could occur, depending on the source of the material used to construct the pads, etc. If the pad-material source is terrestrial, then extraction of material could impact paleontological resources. It is anticipated that the pipeline would not have an associated all-weather road or pads and would be constructed during the winter months from an ice road and pads. Therefore, the only significant impact resulting from pipeline construction would be associated with the placement of vertical support members (VSM's). Depending on the depth at which the VSM's are set it is possible, but highly unlikely, that paleontological resources would be impacted. It is possible that a pump station would be necessary. A pump station would impact about 50 surface acres. The impacts associated with these types of activity have a very low probability of impacting paleontological resources.

(d) Effects of Development Spills: The effects of spills and spill cleanup associated with development would be similar to those associated with exploration activities.

Conclusion—First Sale: Under Alternative B, impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative A. Under Alternative B, the potential impacts to paleontological resources from oil and gas exploration and development may be the same as or only slightly increased from the impacts from activities other than oil and gas under Alternative A.

Multiple Sales: Under Alternative B, potential impacts increase by a factor of two to four, depending on a suite of variables, including infrastructure. The scattered nature of paleontological deposits and the fact that the locations of most remain unknown, make it somewhat difficult to assess the likelihood and severity of potential impacts.

Conclusion—Multiple Sales: Under Alternative B, potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative A, but the probability of impacts occurring might increase. Under Alternative B, the potential impacts to paleontological resources from oil and gas exploration and development would increase dramatically compared to Alternative A, because only seismic activities would be permitted under Alternative A.

Effectiveness of Stipulations: The current clearance process and Stipulation 79 is adequate to protect paleontological resources in the NPR-A through the leasing process. However, any postleasing activity engaged in by the lessee will require an action-specific NEPA document tiered off this or other EIS's. The protection of paleontological resources in the planning area will follow the established and proven procedures developed by the BLM during the NPR-A exploration of the late 1970's and early 1980's, and explicit paleontological resource protocols for EA's will be specified in this EIS.

3. Water Resources:

a. Activities Other than Oil and Gas Exploration and Development:

Ground-impacting-management actions within the planning area that may affect water resources under Alternative B would be similar to those in Alternative A, except that the number and frequency of camps and moves would increase slightly. The increase would depend on management actions in land, water, and resource monitoring as related to leasing activities. Because Alternative B emphasizes protection of surface resources, the streams and lakes identified as critical habitat would be unavailable to leasing. Therefore, any additional camps and moves likely would be outside of these critical habitat areas, and the increase would be the least compared to the other leasing options of leases sold and proposed exploratory activity that occurs. Because critical aquatic habitat would be unavailable to leasing, any additional camps and moves likely would be outside of these critical habitat areas, and the increase would be the least compared to the other leasing options considered in this IAP/EIS.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration:

(a) Drilling Wastes: The preferred and normal means of disposing of drilling wastes, including muds and cuttings, is reinjection into wells. Cuttings may be stored temporarily to facilitate reinjection and/or backhaul operations. Use of mudpits may be allowed by BLM's Authorized Officer (AO). If muds and cuttings are stored on the surface, sediments and other contaminants could be flushed into the watershed. The potential for this impact, however, would be reduced by requiring that wastes be stored in lined and bermed areas and disposed of prior to spring breakup.

(b) Disturbance: Seismic activities probably would increase slightly (Sec. IV.A.1.c) but would still occur seasonally at transitory locations, when snow is sufficient to cover the tundra and lakes and rivers are frozen. Because the proposed exploratory drilling would occur in the winter, the principal effects on water resources would be the construction of ice roads and pads. Construction of ice roads allows winter overland transport of the equipment and material used in exploration- and delineation-well drilling. Ice pads are constructed to support drill rigs and staging activities. While this is preferable to summer surface activities, the ice roads and pads require large quantities of water be available—an estimated 1.0 to 1.5 million gallons per mile of road and 0.5 million gallons per pad. Water supply for drilling as well as for camp use also will be significant (Sec.

IV.A.1.b). Because all but the largest lakes and riverine pools are subject to dewatering if consumptive use is high water, so prevalent in summer, could be limiting in winter. Removal or compaction of snow cover from surface activities also can increase the depth of freezing, greatly reducing the water quantity within a lake or pool. Augmenting snow cover by using snow fences would not only reduce ice buildup on lakes and rivers, but melted snow could be used in ice roads. Use of aggregate ice chips created from crushed lake ice could reduce water usage on ice roads but would greatly increase the depth of freezing in the lakes used in this process. Shallow ponds and lakes that normally would freeze to the bottom are a potential source for this ice aggregate.

(c) **Spills and Spill Cleanup**: Under the proposed exploration activities, the most likely spill cleanup would involve refined-petroleum products, probably from fuel-storage areas or during use in the operations. The size of such spills is likely to be small. The types and amounts of spills estimated for this alternative are discussed in Section IV.A.2. Storage of fuel in lined and bermed areas and the onsite availability of absorbents and removal equipment will help ensure that the size of any area affected by a spill and cleanup efforts is kept to a minimum. Because Alternative B allows for the most restrictive leasing area and conditions, spills from exploration activities would be the least of the leasing alternatives considered in this IAP/EIS.

(2) **Development**:

(a) **Effects of Disturbance**: The proposed development would involve constructing ice roads to haul equipment and gravel for the construction of production pads, roads connecting pads, and landing strips. The gravel most likely would be extracted from existing borrow sites east of the NPR-A (Sec. IV.A.1.b). While this type of proposal will help minimize adverse effects, the potential impacts of oil and gas development on the water resources in the planning area may include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst), blockages of natural channels and floodways that disrupt drainage patterns, increased erosion and sedimentation, and removal of gravel and water from riverine pools and lakes.

1) **Thermokarst**: Thermokarst refers to ground subsidence that occurs when the removal of surface cover exposes ice-rich permafrost to a higher temperature regime and subsequent melting. Stream banks and lakeshores are particularly vulnerable to thermokarst, because the wave action of the water will accelerate the removal of the degrading protective cover. Fine-grained sediments are the most likely to contain ice-rich permafrost, resulting not only in extensive thermokarst but also in increased sediment erosion and changes to stream channel and bed morphology. With the exception of the Colville and Ikpikpuk rivers and the largest lakes, most of the streams and lakes in the planning area have banks or shorelines that consist largely of fine-grained sediments.

2) **Drainage Disruption**: Natural drainage patterns can be disrupted when activities or structures divert, impede, or block flow in stream channels, lake currents, or shallow-water tracks. Blockages or diversions to areas with insufficient flow capacity can result in seasonal or permanent impoundments. Diverting stream flow or lake currents also can result in increased bank or shoreline erosion and sedimentation as well as potential thermokarst. Proper siting and adequate design capacity of culverts, bridges, pipelines, and other structures will minimize drainage problems.

3) **Erosion and Sedimentation**: In addition to thermokarst and drainage alteration, erosion and sedimentation can be caused by construction activities or vehicular crossings, especially during periods of high stream flow or lake levels. Inadequate design or placement of structures, culverts, or bridges can alter natural sediment transport and deposition, creating scour holes or channel bars. Improper placement or sizing of gravel fill can result in erosion from pads or roadbeds adjacent to streams or lakes. Winter or low-water construction and transport activities and adequate armoring of fill will minimize erosion and sedimentation problems.

4) **Gravel Removal**: While much of the gravel used for the construction of permanent facilities will be obtained from permitted sites east of the planning area, some material sites may be required within the planning area. Improper siting of gravel-removal operations can result in changes to stream channel or lake configuration, stream-flow hydraulics or lake dynamics, erosion and sedimentation, and ice damming and aufeis formation. Locating gravel pits far enough away from streams and lakes to avoid breakup or storm flooding will greatly minimize these effects to water resources. While gravel sources are scarce in the planning area, sand and silt are more abundant. Composite or All Season pad designs, using a mixture of gravel, sand, and silt layered with styrofoam and geotextiles, significantly can reduce gravel requirements (Sec. IV.A.1.b).

5) **Water Removal**: Consumptive water use in the summer seldom is a problem on the coastal plain, as water generally is abundant. Exceptions would be in smaller coastal streams or most foothills streams during late summer, when shallow pools might be pumped dry. In the winter, however, all but the largest lakes and riverine pools are subject to dewatering if consumptive use is high. Removal or compaction of snow cover also can increase

the depth of freezing, greatly reducing the water quantity within a lake or pool. Augmenting snow cover by using snow fences not only would reduce ice buildup on lakes and rivers, but melting snow also could be used as a supplemental water source.

(b) Spills and Spill Cleanup: Because Alternative B allows for the most restrictive leasing area and conditions, spills from exploration and delineation activities would be the least of the leasing alternatives; the effects of spills on water quality are analyzed in Section IV.C.4

Under the proposed development activities, spills and spill cleanup would involve both crude oil and refined-petroleum products, probably from fuel-storage areas or handling operations. The types and amounts of spills estimated for this alternative are discussed in Section IV.A.2. Crude- oil-spill cleanup from production operations and pipelines is possible and could adversely affect streams and lakes. Spill cleanup in the watershed would involve containing the spill, diverting or isolating it within the waterbody, skimming off the oil, and treating the remaining oil-contaminated water and sediments. Prevention and rapid response with adequate removal equipment would minimize effects; spill-prevention and -response measures are described in Section IV.A.4.

Conclusion—First Sale: The impacts of activities other than oil and gas exploration and development under Alternative B are expected to be similar to those under Alternative A. The potential long-term impacts of oil and gas development activities on the water resources in the planning area include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst) and blockages of natural channels and floodways that disrupt drainage patterns. The potential short-term impacts, primarily during construction, would increase erosion and sedimentation and water removal from riverine pools and lakes. While any surface-disturbing activity could affect water resources, the potential adverse effects of Alternative B, because it excludes the critical lake and river habitat from leasing, while significant, would be the least of all the leasing options.

Multiple Sales: While the effects of oil and gas exploration and development from multiple lease sales may be up to several times greater than a single sale, impacts would not necessarily go up proportionally. Shared use of infrastructure such as airfields, roads, camps, and pipelines, significantly could reduce the size of the impacted areas and adverse effects to the water resources.

Conclusion—Multiple Sales: Shared infrastructure could reduce the adverse effects to water resources of multiple lease sales, because combined facilities require less water for construction, maintenance, and camp use than separate, independent facilities..

Effectiveness of Stipulations: The stipulations that are effective in protecting the water resources under Alternative B are the same as described under alternative A. Also, measures that ensure proper site selection, design, and construction of structures located near or across lakes would minimize effects. In addition, measures that aid in the prevention of spills and require rapid cleanup response with adequate equipment in the event of a spill would be effective in minimizing impacts of oil and gas exploration and development activities.

4. Effects on Water Quality:

a. Activities Other Than Oil and Gas Exploration and Development: As discussed under Alternative A, ground-impacting management actions other than seismic operations and other oil and gas activities would not impact water quality.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Exploration activities within the planning area that may affect water quality under Alternative B are 2-D and 3-D seismic activity beyond that described under Alternative A, ice-road construction, pad construction, and drilling-fluid storage and disposal. Under this alternative, total miles of seismic trails would be about twice that for Alternative A. That is, water quality could be degraded over a total of 1,800 acres. Spillage is predominantly attributable to development activities, and a discussion of spillage is more appropriately deferred to the following analysis of development impacts.

Use of water for ice-road construction could affect water quality in four ways. Because ice roads would be rerouted every year to minimize tundra disturbance, effects on water quality from any of these mechanisms would be short term, lasting generally one season.

First, the winter extraction of water or ice from NPR-A waters could change the chemistry of those waters. Ice roads require 1.0 to 1.5 million gallons per mile of road, over tens of miles distance. Alternatively, ice chips from frozen lakes could be used in conjunction, lessening the demand for unfrozen water sources. Ice-road construction on the North Slope generally starts no sooner than December to ensure that the tundra is solidly frozen to avoid disturbance, and because ice building requires consistent, very cold temperatures. By December, shallow ponds and lakes, those less than about 3-ft deep, are frozen solid. The preferred lake would be no more than 6 ft deep. Water could be extracted from deeper lakes, but these lakes are likely have fish that would be put at risk from water removal. The number of lakes with the "preferred" water depth are a relatively small subset of the NPR-A surface waters. Thus, road builders would prefer to extract the maximum possible from such lakes, with perhaps extraction of most of about the 3 ft of water that would be left unfrozen by December in a 6-ft deep lake.

As NPR-A surface waters freeze, salts are excluded from the forming ice into the underlying water, increasing salinity. In coastal tundra waters, the alkalinity is associated with the salt content, and increases and decreases in alkalinity parallel those of salinity. Pumping water from a freezing lake would remove the more saline and more alkaline water from under the lake ice. During snowmelt, the removed waters would be replaced by less saline, less alkaline runoff water. In lakes <6 ft deep, which freeze to the bottom, the salts normally would be frozen out of the entire water column and extruded into the sediment thaw bulb underlying the lake. These salts are then only slowly and partially leached back into the water column the following summer. For such lakes, the early summer condition would be low salinity, low alkalinity water, regardless of whether water was removed for ice-road construction. These lakes are only weakly, but still apparently adequately, buffered against acid snowmelt based on observed lake pH's (Sec. III.A.2.b).

In lakes >6 ft deep, the salts and alkalinity excluded from ice formation normally would remain in the never-frozen bottom water. These lakes start the summer with more saline, relatively strongly buffered waters underneath the melting ice. Winter removal of more saline water underneath the ice would result in less saline, less buffered lake waters in early summer following winter water extraction. Thus, following winter extraction of water, their early summer chemistry would be more similar to that of lakes <6 ft deep.

A second way that ice-road construction could affect water quality would be road construction over lakes deep enough not to freeze to the bottom. Many of these lakes are only a foot to a few feet deeper than the minimum 6-ft depth necessary to maintain some unfrozen bottom water in winter. An ice road across such an intermediate-depth lake would be designed to freeze the entire water column below the road, isolating portions of the lake basin and restricting circulation. With mixing thus reduced, isolated water pools with low oxygen could result. Dissolved oxygen concentrations could be reduced below the 5-ppm dissolved oxygen standard needed to protect resident fish (ADEC, 1997).

A third way that ice-road construction could affect water quality would be through changes in water chemistry along the roadbed during and after meltout. As described above, the water withdrawn from lakes to construct the roadway is relatively saline, more saline than typical snowmelt waters. In addition, the salts frozen into the ice road would leach out of the ice prior to its melting during snowmelt, increasing initial salt content of the meltwater. This effect may be measurable during initial snowmelt, but the effect on water quality should be minimal and local, most likely expressed as a slight buffering of pH during initial snowmelt.

A fourth way that ice-road construction could affect water quality would be through modification of the local hydrology along the ice road. The minimum ice-road thickness would be 6 in. Snow drifts against this low elevation would extend only a few feet beyond the road bed with average water content of only a fraction of an inch. However, the 6 in roadbed would dam waters upslope of the roadway, affect local drainage, and restrict water supply downslope of the roadway. Because snowmelt runoff is in excess of coastal tundra dead-storage capacity (Miller, Prentki, and Barsdate, 1980), the restricted water supply on the downslope side of the ice road should have a very local, but otherwise negligible effect. In Prudhoe Bay, flat, thaw-lake plains have been shown to be the land classification most vulnerable to hydrologic effects of road and pad construction (Walker et al., 1987, 1989; Robertson, 1989). In such terrain, impoundments (ponding) and thermokarst along gravel roads and pads equally covered as much additional area as did the pads and roads, despite drainage culverts. Ice roads would persist and impound water during a significant portion of the snowmelt period, for perhaps up to a month. Most annual runoff in coastal tundra occurs during this brief snowmelt period (Miller, Prentki, and Barsdate, 1980). The ecology and, therefore, likely water quality of impoundments upslope of gravel structures at Prudhoe Bay, are similar to those of natural ponds, with the exception that the impoundments are more ephemeral (Kertell, 1996). Ecology of these less-persistent impoundments along ice roads should be a cross between those of wet tundra and ponded tundra. Because the 6-in thickness of ice roads is only 4 to 10 percent of the 5- to 13-ft thickness of a gravel road, the impoundments upslope of an ice road should be proportionately less in area than for a gravel road, or about equal to 10 percent of the area covered by the ice road.

The thermokarst erosion along roads and pads at Prudhoe Bay was considered by Walker et al. (1987) to be a delayed, synergistic impact that occurred primarily on thaw-lake plains. It did not occur on river floodplains at Prudhoe Bay because of minimal ground ice. Thermokarst erosion was attributed to vegetative disturbance and to thermal effects of road dust, flooding, and flaring operations. Because of the lack of vegetative disturbance, the lack of road dust, and minimal upslope impoundment, thermokarst effects are likely to be negligible for one-time use winter ice roads.

Use of water for construction, drilling, and domestic (crew) needs could affect water quality, as discussed for ice-road construction. Effects during exploration on water quality from any of these mechanisms would be short term, lasting generally one season.

For Alternative B, annual ice-pad and -road construction could cover about 310 acres during each year of exploration, assuming that ice-road length would be similar to the assumed connecting pipeline length for this alternative. This ice-road construction would require winter extraction of water that would affect up to 110 acres of intermediate depth (6-ft)—nearby lakes. Pad construction, drilling, and crew needs together would require water use equivalent to 2 acres of lake. Temporary upslope impoundment of snowmelt waters could cover another 30 acres. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation. In the unsuccessful exploration scenario, ice-pad and -road construction would occur only in one winter.

The preferred and normal means of disposing of drilling wastes, including muds and cuttings, is reinjection into wells with no impacts to surface water quality. Mud pits and discharge of exploration drilling muds and cuttings will be prohibited. This analysis assumes direct reinjection of drilling fluids. Under this scenario, there likely will be no impact from drilling fluids used in exploration.

Nevertheless, cuttings may be stored temporarily to facilitate reinjection and/or backhaul operations and, in some cases, use of reserve pits may be allowed by BLM's AO. Such establishment of temporary reserve pits could degrade nearby water quality. Elevated levels of trace metals in water (zinc and chromium) and sediments (copper, chromium, and lead) have been found in ponds at least as far as 700 ft from reserve pits elsewhere on the North Slope (Woodward et al., 1988). Elevated levels of petroleum hydrocarbons also were found in water and sediment in the same study. Waters from the reserve pits and some ponds within 160 ft but not at greater distances were found to be toxic to a sensitive zooplankton species in bioassays. Spread of contaminants from these reserve pits was to overflow of the pits during snowmelt, the practice of draining the snowmelt overflow from pits on to the tundra, and to seepage.

Requiring the pits to be lined and bermed would not necessarily protect tundra from this contamination. Berms increase snow drifting, increasing the overflow problem. Historically, because clay is the standard liner for waste pits, the clay in drilling muds has been assumed alone to be adequate as a pit liner. However, the chemical formulation of drilling muds is designed to keep the drilling mud dispersed, which can eliminate its ability to act as a seal. The potential for impact from pit-stored drilling fluids would be reduced if fluids were properly disposed of prior to spring breakup.

(2) Development: There would be no development effects on water quality, if exploration efforts found no commercially recoverable oil. Under the high-resource scenario for this alternative, development would occur. Development activities within the planning area that may affect water quality under Alternative B for the high-resource scenario are ice-road and pad construction and spills. There will be no impact from drilling fluids used in development. Mud pits and discharge of drilling fluids and produced waters will be prohibited. Muds and cuttings will be either disposed downhole or removed from public lands to ADEC-approved waste-disposal facilities. Produced waters will be reinjected. Some washed cuttings could be used in gravel-road or pad construction. Crude-oil and waterflood pipelines would be aboveground, and their construction and physical presence would have a negligible affect on water quality.

For Alternative B, because of the annual rebuilding of ice roads, annual water use during development would be similar to that for exploration, needing water to construct 300 acres of ice road, with the water being obtained from about 110 acres worth of intermediate-depth lakes. During the seasonal construction phase, annual field-water demand would be on the order of 37 acre-feet, requiring at least a surface water source of 12 additional acres. After major construction is finished, annual field-water demand would decrease to about 15 acre-feet/year, requiring water removal from only about a 5-acre source. Some of this water likely would come from lakes >6-ft deep, because shallower lakes freeze solid by late winter. Temporary upslope impoundment of snowmelt waters by ice roads could cover another 30 acres. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

Gravel construction of pads and within-field roads with air strip would cover about a 100-acre footprint for a single field and require a million cubic yards of gravel. The preferred sources for gravel are existing borrow pits on the east side of the Colville River. In recent decades, suction dredges have been used in the NSB to mine sand and gravel from the Colville River Delta at Nuiqsut; the Mead and Kokolik rivers; lakes at Atqasuk and Barrow; and lagoons at Barrow, Wainwright, and Kaktovik (Walker, 1994). Dredged holes took a few to many years to refill. Dredging increased upriver-bottom erosion by steeping river slopes in the Colville River, but the primary environmental effect attributed to NSB dredging has been expansion of fish overwintering areas. Fish populations and, therefore, water quality do not appear to be adversely affected by this dredging activity (Walker, 1994). Because gravel is a scarce commodity, alternative construction technology could be refined to lessen gravel use and associated impacts, but such alternatives are not assumed.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion (Walker et al., 1987). Thermokarst erosion can result in water features with high turbidity/suspended-sediment concentrations, as discussed under Alternative A. The thermokarst erosion is due partly to the thermal effects of dust blown off the gravel onto the tundra. Thermokarst erosion could cause the State turbidity standard to be exceeded within and down flow of thermokarst features. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel or over up to 200 acres for development in Alternative B. Ecology of impounded waters appears to be similar to that of similarly sized ponds, but impoundments are more ephemeral (Kertell, 1996).

Although downslope drying of tundra because of upslope impoundment is possible, spring snowmelt generally is expected to be in excess of watershed dead storage in coastal tundra and would limit effect of downslope drying on water quality. Snow drifts develop on the sides of elevated roads that also limit downslope drying. In addition, most flowing water makes it across the road through culverts; the road-impounded waters are a small portion of the total flow. Standard North Slope practices in gravel road construction includes culverts to limit disturbance of drainage patterns (Robertson, 1989). In defined drainages, multiple culverts are constructed to accommodate breakup flow as well as summer flow. In flatter tundra, single culverts are spaced at intervals to limit ponding of sheet flow during breakup.

Spills are another impacting agent on water quality. A number of small crude spills averaging 4 bbl and smaller fuel spills averaging 0.7 bbl are projected to occur under Alternative B. However, roughly 75 percent of crude spills and likely all fuel spills would occur on pads or roadbeds off the tundra surface. Spill response would remove almost 100 percent of a spill from frozen tundra prior to snowmelt for two-thirds of the year. During one-third of the year, late May through late September, spills could reach and impact tundra waters before oil-spill response is initiated or completed. Thus, at most, about 8 percent of crude spills (25% X 33%) could be reasonably anticipated to reach tundra waters. For Alternative B, this calculation results in an estimate of 6 spills, averaging 4 bbl, reaching tundra waters.

Dissolved-oxygen concentrations in tundra waters could be affected by spilled oil in summer. In one NPR-A experiment (Sec. IV.A.1.b.(2)), 5 bbl of Prudhoe Bay crude was spilled into a 0.07-acre tundra pond. Dissolved-oxygen concentrations a week after the spill were reduced by about 4 mg/l below levels in a control pond, in some measurements to less than the 5 mg/l State standard for protection of wildlife. In 2 in of water underneath the spill, oxygen concentrations were measured at 0.7 to 0.9 mg/l versus 5 mg/l in the control pond. At 3-in water depth, oxygen concentrations under the slick increased to 3.9 to 6.9 mg/l versus 8.2 to 10.7 mg/l in the control pond. At 4-in water depth (average pond depth, Miller, Prentki, and Barsdate, 1980), outside the slick, oxygen concentration was within the expected normal range, 10.8 mg/l versus 11.4 mg/l in the control pond. The oxygen deficit under the slick and also in shallower waters of the control pond were attributable to decreased oxygen influx from the air and the relatively high rate of (natural) sediment respiration in coastal tundra ponds, not to oil-enhanced respiration in the pond.

In winter, even under ice, an oxygen deficit would not be expected to result from a small spill in most waters. In winter, sediment (and water column) respiration rates are negligible. In addition, sediment respiration has a lesser relative effect in the thicker water column of lakes deep enough not to freeze solid in winter. Such lakes, even those that hold fish, tend to be supersaturated with dissolved oxygen in winter, to levels above the State water-quality standard of 110 percent saturation (Sec. III.A.2.b). An exception might be if a spill occurred underneath thick ice cover in very restricted waters holding a concentrated overwintering fish population that has already depleted oxygen levels. Occasional low oxygen concentrations and overwintering fish kills have been observed North Slope waters in the past.

However, the primary effect of a small spill on tundra water quality would be from direct toxicity rather than from oxygen depletion or other secondary effects. Long-term toxicity (7 years) can result from a small spill, as shown in the NPR-A experimental pond spill. That spill killed the zooplankton, and the pond water remained toxic to more sensitive zooplankton species for 7 years.

In a real spill, response likely would recover the bulk of spilled oil, but sufficient oil could remain to promote long-term, local toxicity. Over the life of a field, spills could affect the water quality of about six ponds or small lakes, making their waters toxic to sensitive species for about 7 years.

Summary: Primary affecting agents for Alternative B are water extraction, water impoundment, and thermokarst around seismic trails, structures, and roads, and oil spillage.

Thermokarst erosion of seismic trails could result in degraded long-term water quality over about 1,800 acres.

During exploration, annual ice-pad and road construction (310-acre footprint each year), drilling, and domestic needs for water could require winter extraction of the unfrozen water from about up to 120 acres of nearby lakes. Most of this water use is for ice roads. Temporary upslope impoundment of snowmelt waters could cover another 30 acres. If exploration continues >1 year, the areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

If development occurs (the high-resource scenario), because of the annual rebuilding of ice roads, annual water use during development would be similar to that for exploration, needing water to construct 300 acres of ice road, requiring water from 120 acres worth of intermediate-depth lakes. During the seasonal construction phase, annual field-water demand would be on the order of 37 acre-feet, requiring water from 12 additional acres of lake. After major construction is finished, annual field-water demand would decrease to about 15 acre-feet/year, requiring water removal from only about 5 acres of lake.. Temporary upslope impoundment of snowmelt waters by ice roads could cover another 30 acres. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. The thermokarst erosion is due partly to the thermal effects of dust blown off the gravel onto the tundra. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or over up to 200 acres for development in Alternative B. Unlike the situation for ice structures, the same 200 acres would be affected each year over the life of the field.

Over the life of a field, spills could degrade water quality of about six ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years.

Conclusion—First Sale: Longer-term (decade-or-more) effects of Alternative B would be about twice that for Alternative A because of the introduction of oil and gas activities, especially additional seismic activities. Additionally, water quality over a few hundred acres could be annually affected by construction or placement of ice roads. Oil spills could result in waters of about six ponds or small lakes remaining toxic to sensitive species for about 7 years.

Multiple Sales: Effects of seismic trails would be similar to those for one sale, affecting 1,800 acres. During peak exploration, annual ice-pad and -road construction could cover about 370 acres, assuming that ice-road length would be similar to the assumed connecting pipeline length for this alternative. This ice road construction would require winter extraction of water from about up to 130 acres of nearby lakes. Pad construction, drilling, and crew needs together would require water use equivalent to 2 to 4 acres of lake. Temporary upslope impoundment of snowmelt waters could cover another 40 acres.

Because of the continued need for ice roads, annual water use during development for ice-road construction would be similar to that for exploration, requiring water from 130-acres worth of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 10 acres of lake for water supply for all fields. Temporary upslope impoundment of snowmelt waters by ice roads could cover another 40 acres.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or 200 acres total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 400 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields. Over the life of development resulting from multiple sales, spills could degrade water quality of about eight ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years.

Conclusion—Multiple Sales: Longer-term (decade-or-more) effects of multiple sales would be similar to those for a single sale. Oil spills could result in waters of about eight ponds or small lakes remaining toxic to sensitive species for about 7 years.

Effectiveness of Stipulations: Stipulation 16 would limit winter water extraction from lakes >7 ft deep and prohibit winter extraction from streams, rivers, and lakes <7 ft deep containing fish. Extraction of water from lakes >7 ft would be limited to 15 percent of the estimated ice-free volume. The average depth of lakes >7 ft deep likely are close to 8 feet on the North Slope; most lakes on the North Slope are <6 feet deep (Sloan, 1987). The average ice thickness in the December-January ice-road building season is 3.5 ft, giving a stipulation-allowable extraction of 0.7 ft of water (15% of 5.5 ft of water). The stipulation would protect the water quality of fish-bearing lakes and lessen the effect on any single lake. A tradeoff would a lesser magnitude effect over a greater (4x) acreage of lakes.

Stipulations 20a and 20j are ineffective in protecting water quality and actually could increase water-quality effects as discussed under Alternative A.

Downhole disposal is identified as the preferred disposal method in Stipulation 13. However, the AO has the authority under Stipulation 13 to allow the use of temporary mud (reserve) pits. This EIS assumes the preferred procedure, downhole disposal, or direct removal from public lands to ADEC-approved waste-disposal facilities, without storage in temporary mud pits. The use of temporary mud pits is discouraged by the ADEC and is no longer the practice on the North Slope. To allow mud pits, the AO would have to both win ADEC's approval and conduct a site-specific NEPA evaluation.

5. Air Quality:

a. Activities Other than Oil and Gas Exploration and Development: The ground-impacting activities that affect air quality under Alternative B would be the same as those under Alternative A. The impacts of these activities would be the same as those under Alternative A.

b. Oil and Gas Exploration and Development Activities. This discussion analyzes the potential degrading effects on air quality by the activities and developments induced by Alternative B. Supporting materials and discussions are presented in Section III.A.3.b (Description of Air Quality).

(1) Effects of Routine Emissions: The following air pollutants would be produced during activities conducted as a result of this alternative: nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM), and volatile organic compounds (VOC).

Nitrogen oxide consists of both nitric oxide (NO) and nitrogen dioxide (NO_2). The nitrogen oxides (No_x) are formed from the oxygen and nitrogen in the air during combustion processes, and the rate of formation increases with the combustion temperature. Nitric oxide, the major component of the combustion process, will slowly oxidize in the atmosphere to form NO_2; NO_2 and VOC perform a vital role in the formation of photochemical smog. Nitrogen dioxide breaks down under the influence of sunlight, producing NO and atomic oxygen, which then combine with diatomic oxygen to form O_3 or with VOC to form various gaseous and particulate compounds that result in the physiological irritation and reduced visibility typically associated with petrochemical smog.

Carbon monoxide is formed by incomplete combustion. It is a problem mainly in areas where there is a high concentration of vehicle traffic. High concentrations of carbon monoxide present a serious threat to human health, because they greatly reduce the capacity of the blood to carry oxygen.

Sulfur dioxide is formed in the combustion of fuels containing sulfur and, in the atmosphere, SO_2 slowly converts to sulfate particles. Sulfates in the presence of fog or clouds may produce sulfuric-acid mist. It is generally recognized that entrainment of sulfur oxides or sulfate particles into storm clouds is a major contributor to the reduced pH levels observed in precipitation (acid rain) in the northeastern U.S.

Emissions of particulate matter associated with combustion consists of particles in the size range <10 microns in diameter (PM-10). Emissions of particulate matter associated with combustion consists of particulates, especially those in a certain size range of 1 to 3 microns, can cause adverse health effects. Particulates in the atmosphere also tend to reduce visibility.

The type and relative amounts of air pollutants generated by operations vary according to the phase of activity. There are basically three phases: exploration, development, and production. For the exploration phase, emissions would be produced by (1) diesel-power-generating equipment needed for drilling exploratory and delineation wells; (2) truck and other vehicles used in support of drilling activities; and (3) intermittent operations such as mud degassing and well testing. Pollutants generated primarily would consist of NO_x (these would consist of NO and NO_2 [nitrogen dioxide]; ambient air standards are set only for NO_2), CO, and SO_2. The impact of exploration and delineation activities conducted as a result of this alternative would be limited to between 1 to 10 wells.

For the development phase, the primary emission sources would be (1) piston-driven engines or turbines used to provide power for drilling; (2) heavy construction equipment used to install modules and pipelines; and (3) various vehicles. The principal development-phase emissions would consist of NO_2 with lesser amounts of SO_2, CO, and PM.

For the production phase, the primary source of emissions would be from power generation for oil pumping and water injection. The emissions would consist primarily of NO_2

with smaller amounts of CO and PM. Another source of air pollutants would be evaporative losses (VOC) from oil/water separators, pump and compressor seals, valves, and storage tanks. Venting and flaring could be an intermittent source of VOC and SO_2. The impact of development and production activities associated with Alternative B would consist of the construction of two production pads drilling a maximum of 83 wells and constructing approximately 75 mi of pipelines. Production would reach a peak of 35 MMbbl per year. Clean Air Act standards would be used to establish the maximum concentrations of allowable pollutants for each operation proposed.

Other sources of pollutants related to operations are accidents such as blowouts and oil spills. Typical emissions from accidents consist of hydrocarbons; only fires associated with blowouts or oil spills produce other pollutants.

Federal and State statutes and regulations define air-quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods (Table III.A.2-1). These maxima are designed to protect human health and welfare. However, one exceedance per year is allowed except for standards based on an annual averaging period. The standards also include Prevention of Significant Deterioration (PSD) provisions for NO_x, SO_2, and PM-10 to limit deterioration of existing air quality that is better than that otherwise allowed by the standards (an attainment area). Maximum allowable increases in concentrations above a baseline level are specified for each PSD pollutant. There are three classes (I, II, and III) of PSD areas, with Class I allowing the least degradation. Class I also restricts degradation of visibility. This area is a Class II, which allows for an incremental decrease in the air quality of the area. Baseline PSD-pollutant concentrations and the portion of the PSD increments already consumed are established for each location by the U.S. Environmental Protection Agency (USEPA) and the State of Alaska prior to issuance of air-quality permits. Air-quality standards do not directly address all other potential effects such as acidification of precipitation and freshwater bodies or effects on nonagronomic plant species.

(2) Effects of Accidental Emissions: Accidental emissions result from gas blowouts, evaporation of spilled oil, and burning of spilled oil. Soot from a fire is considered to be the major contributor to pollution from a fire event. This soot, which would be deposited on plant materials in the vicinity of the fire, would tend to slump and wash off vegetation in subsequent rains, limiting any health effects. Accidental emissions, therefore, are expected to have a minimal effect on onshore air quality.

(3) Other Effects on Air Quality: Other effects of air pollution from activities and other sources on the environment not specifically addressed by air-quality standards include the possibility of damage to vegetation and acidification. Effects may be short term (hours, days, or weeks), long term (seasons or years), regional (Arctic Slope), or local.

A significant increase in ozone concentrations is not likely to result from the exploration, development, or production scenario associated with the IAP. Photochemical pollutants such as ozone are not emitted directly but rather form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present in the sale area most of each day during the summer, temperatures remain relatively low (Brower et al., 1988). Also, activities occurring as a result of the field-development scenario of the IAP are separated from each other, diminishing the combined effects from activities discussed in the IAP.

Olson (1982) reviewed susceptibility of fruticose lichen, an important component of the coastal tundra ecosystem, to sulfurous pollutants. There is evidence that SO_2 concentrations as low as 12.0 micrograms per cubic meter ($\mu g/m^3$) for short periods of time can depress photosynthesis in several lichen species, with damage occurring at 60 $\mu g/m^3$. Also, the sensitivity of lichen to sulfates is increased in the presence of humidity or moisture, conditions that are common on coastal tundra. However, because of the small size and number of sources of SO_2 emissions, the ambient concentrations at most locations may be assumed to be near the lower limits of detectability. Because of the distance of the proposed activities from shore, attendant atmospheric dispersion, and low existing levels of onshore pollutant concentrations, the effect on vegetation resulting from the IAP is expected to be minimal.

Summary: The effects on air quality from Alternative B should result in air emissions that are below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected.

Conclusion—First Sale: Activity associated with Alternative B would result in a small, localized increase in the concentrations of criteria pollutants. Concentrations would be within the PSD Class II limits and National Air Quality Standards. Therefore, effects from Alternative B would be low. Effects of activities other than oil and gas are negligible, as in Alternative A.

Multiple Sales: The effects on air quality from multiple sales should result in air emissions that remain below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected.

Conclusion—Multiple Sales: Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.

Effectiveness of Stipulations: Current laws and regulations are assumed to be in place for the analysis of the IAP, and effects levels reflect this assumption.

6. Vegetation: Ground-impacting actions within the planning area that may affect vegetation under Alternative B include those analyzed under Alternative A and those resulting from oil exploration and development. The impacts of management actions described under Alternative A would be similar under Alternative B, except that the total areal extent of archaeological/paleontological excavations may increase to 2 acres per year and seismic survey activity would increase (see below).

a. Exploration:

(1) Disturbance:

(a) Effects of Construction: Construction with the potential to impact vegetation during exploration would be limited to the construction of ice pads for drilling exploratory or delineation wells, well collars, and ice roads to access some ice pads. Because vegetation is dormant when frozen and the ice pads/roads melt during the spring thaw along with snow and natural ice, this construction may cause "green trails" but normally would have no adverse impact on vegetation. The exception would be if an ice pad were covered to prevent summer melt, so it could be used in a second winter. In that case, the vegetation would thaw underneath the timbers placed around the pad's perimeter to hold the cover down. Because that thawed vegetation would receive no sunlight, it would die (Hazen, 1997). Assuming that the average ice pad is 500 ft by 500 ft, this perimeter death would impact about 2,000 ft^2 or 0.05 acres. Under Alternative B, it is assumed that 1 to 4 exploration wells and 0 to 6 delineation wells would be drilled in the planning area, for a total of 1 to 10 wells on ice pads. If it is assumed that half of all ice drill pads would be maintained over the summer, this scenario could result in the death of 0.0 to 0.2 acres of vegetation spread among 0 to 5 different sites and over 10 years. The vegetation would take 1 to a few years to recover.

Holes are dug in the earth for construction of well collars, causing the destruction of vegetation on the 16 ft^2 of ground (0.006 acres) involved and causing thermokarsting around them, which may change some vegetation cover to a wetter type. For 1 to 10 wells, this could result in the destruction of 0.01 to 0.06 acres of vegetation.

(b) Effects of Seismic Activities: Under Alternative B, it is assumed that one 2-D seismic survey would occur each winter for about 10 years, after which the frequency of surveys would drop to alternate winters. From zero to two 3-D surveys would occur within about 5 years. Thus for 10 years, 2-D surveys would double in frequency from the level analyzed in Alternative A, resulting in 1,850 acres experiencing medium to high disturbance every winter rather than every other winter. Recovery time from this disturbance would be the same as predicted for Alternative A.

It is assumed that a 3-D seismic operation would cover a total area of 150 mi^2 (96,000 acres), or 25 percent of the total area covered by a 2-D survey. However, the number of line miles covered within that area would be much greater, about 1,875. Thus, the tundra area impacted by seismic lines would be about 45,450 acres (1,875 mi by 200 ft wide). As for 2-D surveys, this figure is a maximum, because not all the area within the pair of 100-ft wide lines would be overrun by a vehicle. For 3-D surveys, the distance covered by camp-move vehicles would not be similar to line miles of survey as is the case for 2-D surveys. It is assumed that camp-move trails would approximate 25 percent (62.5 mi) of those for 2-D surveys, because the total area involved in a 3-D survey is only 25 percent of that covered by 2-D. There still would be an average of 106 additional miles traveled when entering and leaving the planning area. Thus, camp-move trails would impact about 610 acres of tundra per survey. Under Alternative B, zero to two 3-D survey would occur, and about 0 to 1,220 acres would be impacted by camp-move vehicles and 0 to 90,900 acres by seismic line as a result of a first lease sale. Because 3-D seismic involves more tight turns by heavy equipment than does 2-D, the potential for vegetation damage is greater. For this reason, it can be assumed that the medium and high disturbance levels to tundra would occur in greater proportions from 3-D seismic lines than that presented for 2-D in Emers and Jorgenson (1997). The total area within the planning area impacted by seismic surveys would be less than the total acreage of surveys presented here, because individual surveys would overlap one another. However, the decrease in acreage impacted would be countered by the higher level of disturbance possible in those areas of overlap.

(2) Effects of Spills: Spills that might occur during exploratory work are covered under blowouts and refined-oil spills during development (below).

b. Development:

(1) Disturbance:

(a) Excavation/Construction: There are four different aspects of oilfield development that would impact vegetation—construction of gravel pads, roads and airstrips for each oilfield; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines.

1) Gravel Pads, Roads, and Airstrips: It is assumed that the gravel fill for the average oilfield in the planning area would cover a total of 100 acres and that under Alternative B, 0 to 1 oilfield would be developed. This would result in the destruction of either 0 or 100 acres of vegetation.

The passage of vehicle traffic over gravel pads would result in dust and gravel being sprayed over vegetation within about 30 ft of the pad and a noticeable dust shadow out to about 150 ft or more. Beyond about 30 ft, the effects of dust on vegetation would be subordinate to those described below for changes in snow distribution and moisture regimes (Woodward-Clyde Consultants, 1993). Within 30 ft of pads, the dust and gravel may smother the original vegetation resulting in a shift to weedy species and thermokarsting, with the latter leading to the development of high-centered polygons with deep moats (Jorgenson, 1997, pers. comm.). For this analysis, it is assumed that the average oilfield in the planning area would consist of 5 mi of some combination of pads, roads, and airstrip with the potential for dust effects along a 10-mi perimeter. This could result in a total coverage of the above impacts over 36 acres per oilfield, corresponding to 0 or 36 acres under Alternative B.

The type of material used for gravel fill also can impact vegetation, because the material sometimes has a saline source. Sources for material to be used in the planning area currently are undetermined. If the material is saline, water draining off or leaching through the pad can pick up the salinity and cause the death of plants near the pad. The area of plant death eventually would be colonized by more halophytic species, resulting in an overall impact of change from one plant community to another.

The construction of gravel pads can result in a change in moisture regime of the nearby tundra through the accumulation of snow by drifting and the blockage of normal surface waterflow in summer. This can cause an increase in the depth of the active layer (soil that thaws during summer), which leads to an increase in graminoid and bryophyte production in wet habitats or a decrease in shrub and lichen production in moist or dry habitats within 164 ft of the pad (Woodward-Clyde Consultants, 1993). In the extreme case, shrubs may disappear altogether and the vascular plant community may become a *Carex aquatilis* monoculture (Jorgenson, 1997, pers. comm.). If all such effects occur within 164 ft of the pads, the total area impacted could be up to 200 acres per oilfield, or 0 to 200 acres under Alternative B.

Flooding caused the greatest indirect effect of construction on vegetation during the first 15 years (1968-1983) of development in the Prudhoe Bay oilfield (Walker et al., 1986, 1987). Flooding resulted when roads and pads intercepted the natural flow of water and caused ponding. Conditions of development in the NPR-A would require that natural drainage patterns be identified prior to and maintained during and after construction. Even if such conditions were not required or were not completely successful, the acreage of land impacted would not be greater than that affected by dust and snow drifting, as described above. However, the change in vegetation type could be different, resulting in more aquatic grasses and sedges.

2) Pump Station: Depending on the number of fields produced, their location, and the diameter of pipe used to transport oil, one pump station may be needed within the planning area. A pump station with associated airstrip would result in about 400 acres of gravel fill. For this analysis, it is assumed the perimeter of this gravel fill would be 3 mi, resulting in 11 acres of potential dust effect or 60 acres of moisture-regime change.

3) Material Sites: Any need for gravel fill resulting from proposed development may be met by existing borrow sites east of the NPR-A. However, if excavation of fill material occurs within the planning area, vegetation would be destroyed over the area of the borrow pit itself as well as where the overburden is stockpiled. For this analysis, it is assumed that there would be one material site within the NPR-A for each oilfield developed, with a total surface disturbance of 30 to 50 acres (average 40 acres). It also is assumed that all associated work would occur in winter, resulting in no dust. Any moisture-regime changes as a result of snow drifting would be confined to <20 acres per material site. Under Alternative B, this would result in the destruction of 0 to 40 acres of vegetation and the alteration of the vegetation community over 0 to 20 acres.

4) Pipelines: For this analysis, it is assumed that pipelines would involve a single VSM per pipe-supporting rack. The VSM would have a diameter of 12 in and would be placed 55 to 70 ft apart. Each oilfield developed would contain about 5 mi of flowline within it in addition to the transport pipeline carrying crude oil from it. Each VSM would have an approximately 20-in wide zone of disturbance around it in addition to the vegetation displaced by the VSM (Jorgenson, 1997, pers. comm.). The zone of disturbance would result from deposition of spoil material and thermokarsting and would result in a change in plant species composition. The total area disturbed by each VSM would be about 14 ft², 6 percent of which would be vegetation destruction/replacement by the VSM. This would result in 0.03 acres being disturbed per pipeline mile, or 0 to 2.5 acres under Alternative B.

Pipelines also could impact vegetation indirectly through snow drifting or shading. There is conflicting information about the occurrence of snow drifting associated with pipelines that have no parallel road. Jorgenson (1997, pers. comm.) has not seen drifting in such situations, but residents of Nuiqsut have said that it occurs. Insufficient information exists to describe any potential effects to vegetation.

Any vegetation under a pipeline would receive less direct sunlight during the growing season, potentially leading to a more shallow active layer in the soil and reduced photosynthesis by the plants. No data exist to address this possibility. Most existing pipelines are associated with a parallel road, and any effects of snow drifting, gravel spray, or dust would mask an effect of shading.

(2) Effects of Spills: Most spills occur on gravel pads and, consequently, their effects do not reach the vegetation. About 20 to 35 percent of past crude-oil spills have reached areas beyond pads. The corresponding proportion for refined oil spills probably is much less, but for this analysis it is assumed that 27 percent of all spills (except blowouts; see below) occur or reach beyond gravel pads. Because winter spans the majority of each year, most spills happen when there is sufficient snow cover that cleanup efforts occur before the oil reaches the vegetation; this situation occurs during about 60 percent of the year. Thus, for this analysis, it is assumed that 11 percent of all spills (except blowouts; see below) will affect vegetation.

Most spills cover <500 ft² (<0.01 acres) with a maximum coverage of 4.8 acres if the spill is a windblown mist. For this analysis, it is assumed that the average spill would cover 0.1 acre (98% at 0.01 acre, 2% at 4.8 acres). Under Alternative B, the total area of vegetation that would be impacted by spilled oil over the lifetime of developed oilfields would be 0.0 to 2.6 acres. Overall, past spills on Alaska's North Slope have caused minor ecological damage, and ecosystems have shown a good potential for recovery (Jorgenson, 19[illegible]

From 1958 to 199[illegible] [illegible] wells were drilled on Alaska's North Slope. During this period, one blowout was reported, and no crude oil was spilled off the pad during that blowout. The chance of a blowout occurring in the planning area, with subsequent damage to vegetation beyond the drill pad, is considered low.

Summary: Under Alternative B, minor impacts to vegetation may occur from aircraft landings, archaeological or paleontological excavations, camps, and overland moves. The duration of these impacts would be short term, ranging up to 4 months, and recovery could vary from 1 year to decades. Impacts also would occur from seismic work and the construction of well collars during exploratory drilling. The duration and recovery for seismic work would be similar to those for overland moves. The effects of well-collar construction would be permanent. The effects of development include the destruction of vegetation under gravel pads; material sites; pipeline VSM's and spilled oil; and the alteration of vegetation communities resulting from dust, salinity of gravel fill, snow drifts, and blockage of normal surface waterflow. These impacts are considered permanent except for those of oil spills, which are cleaned up immediately, allowing recovery within a few years to two decades.

Conclusion—First Sale: Impacts to vegetation from activities other than oil exploration and development under Alternative B would be the same as those under Alternative A, except that the effects of archaeological excavation might increase from 1 to 2 acres. The impacts of oil exploration would include vegetation disturbance on about 7,350 acres per year from 2-D seismic work and 0 to 92,120 acres from 3-D surveys. About 17 percent of the disturbance from 2-D would be medium to high, with perhaps 20 percent at that level for 3-D. After 9 years, recovery would be about 90 percent for 2-D seismic work and probably somewhat less for 3-D. Exploration activities also would result in minor vegetation destruction and alteration from the construction of exploration well collars that would be permanent. The activities of oilfield development that would impact vegetation include construction of gravel pads, roads, and airstrips for each oilfield; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on 0 to 180 acres and the alteration in plant species composition of another 0 to 280 acres, for a total of effects over 0 to 460 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills are inevitable during exploration and development and would affect 0.0 to 2.6 acres of vegetation within the planning area. Spills would be cleaned up immediately, would cause minor ecological damage, and ecosystems would be likely to recover in a few years to 2 decades.

Multiple Sales: It is assumed that additional lease sales under Alternative B would result in additional exploration activities and a total of 0 to 2 oilfields being developed. More acreage would be impacted by seismic surveys, but it would be over a longer period of time. It is expected that recovery from at least 90 percent of the impacts from the earliest surveys would be complete before additional seismic operations would commence as a result of multiple sales. The total number of exploratory wells is assumed to increase from 1-4 to 4-14, and delineation wells from 0-6 to 0-12, for a total of 4 to 26 wells drilled from ice pads. Vegetation destruction from well collars would then increase to affect 0.02 to 0.2 acres, and vegetation death around ice pad perimeters would increase to 0.1 to 0.7 acres. Tundra would recover from the latter in 1 to a few years.

With the assumption of 0 to 2 oilfields developed, the vegetation that might be destroyed by burial under gravel fill would increase to 0 to 200 acres. The area of vegetation around oilfield gravel pads that would undergo change from dust- or moisture-regime impacts would be 0 to 400 acres. The impacts of developing material sites would increase correspondingly to the number of oilfields. This would mean the destruction of vegetation on 0 to 80 acres and effects of moisture regime changes on 0 to 40 acres. It is assumed that the number of pump stations would remain at 0 to 1, resulting in the burial of 0 to 40 acres and dust- or moisture-regime changes on an additional 0 to 60 acres. The number of pipeline miles would increase somewhat under multiple sales, with a total of 0 to 100 mi resulting in the destruction or alteration of a total of 0 to 3.0 acres. The incidence of oil spills also would increase, affecting 0.0 to 3.7 acres of vegetation. The probability of a blowout would remain low.

Conclusion—Multiple Sales: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in only a small increase in the amount of disturbance that would be evident at any one time. Exploration activities also would result in 0.02 to 0.2 acres of permanent vegetation destruction around well collars and alteration of 0.1 to 0.7 acres around ice pads. The activities of oilfield development that would impact vegetation include construction of gravel pads, roads, and airstrips for each oilfield; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on 0 to 320 acres and the alteration in plant species composition of another 0 to 500 acres, for a total of effects over 0 to 820 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills would affect 0.0 to 3.7 acres of vegetation within the planning area. Recovery from spills would take a few years to two decades.

Effectiveness of Stipulations: The above analysis assumes that currently implemented stipulations on overland moves and seismic surveys (Stipulation 20; Sec. II.C.7) would continue to be employed. It also assumes that standard dust-abatement practices, as currently used in North Slope oilfields, would be implemented in the planning area. Snow fences also are currently employed in places. Their purpose, however, is to reduce drifting on pads; the resulting amount of drifting over vegetation would be the same or more.

7. Fish:

a. Activities Other Than Oil and Gas Exploration and Development: Actions associated with Alternative B that may affect fish include the establishment of large work camps at pre-existing airstrips; small scientific excavations for paleontological, geologic, and soils-related information; the sport harvest of fish by workers; and those associated with fuel spills at fuel-storage sites. The establishment of work camps, scientific excavations, and the sport harvest of fish are expected to have no measurable adverse effect on arctic fish populations. Fuel spills at fuel-storage sites may adversely affect arctic fish populations.

b. Oil and Gas Exploration and Development Activities: Alternative B also involves several management actions associated with oil and gas development. These include seismic surveys; the construction of gravel drill pads, roads, airstrips, pipelines; and oil spills (drill pad, pipeline, and supply barge). The individual effects of these actions and the chemical agents associated with them have been discussed in previous Beaufort Sea EIS's (e.g., USDOI, MMS, 1996a), which are herein incorporated by reference. The remainder of this analysis focuses on the amount of exposure arctic fish are likely to have to each of these actions under Alternative B. Approximately 44 percent of the planning area could be exposed to oil and gas development under Alternative B.

(1) Effects of Disturbance:

(a) Effects from Seismic Surveys: Arctic fish are likely to be adversely affected by seismic surveys located above overwintering areas. Likely effects would include avoidance behavior and short-term added stress but also could include the death of some of the more sensitive lifestages (e.g., juveniles). However, the effect on most overwintering fish is expected to consist of only short-term, sublethal effects. While Alternative B is likely to involve more seismic surveys than Alternative A and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Hence, seismic surveys associated with Alternative B are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations). While Alternative B is likely to involve more fuel spills than Alternative A, the amount of fuel entering fish habitat is not expected to significantly increase. Hence, fuel spills associated with Alternative B are expected to have the same overall effect on fish populations as discussed for Alternative A (i.e., no measurable effect on arctic fish populations).

(b) Effects from Construction:

Construction-related activities that may affect arctic fish include the construction of drill pads, roads, airstrips, and pipelines; and possibly gravel extraction. During exploration there will be no pipelines; and drill pads, roads, and airstrips (if needed) will be constructed of ice. Depending on where the construction and the freshwater withdrawals needed for construction occur, these activities could adversely affect arctic fish. For example, some overwintering areas are relatively shallow (<10 ft) and have a very limited supply of freshwater and dissolved oxygen below the thickening winter ice. The construction of an ice road or airstrip through such areas would freeze to the bottom and form a barrier to water circulation, resulting in reduced levels of dissolved-oxygen. This could have lethal effects on the overwintering fish affected by the barrier. Additionally, freshwater withdrawals may adversely affect fish if the water is taken from areas where they are overwintering. During winter, arctic fish concentrate in overwintering areas, which are relatively small in size and few in number. Their survival at these overwintering sites depends on an adequate supply of freshwater and dissolved oxygen. Each mile of ice road requires up to 1.5 million gallons of water to construct. Another .5 million gallons are required for each drill pad. Sources of freshwater within the planning area vary greatly in the amount of under-ice water available for construction during winter. Most bodies of water are relatively shallow (≤6 ft), do not support resident fish populations, and are frozen to the bottom in winter. Those deep enough to permit under-ice withdrawals for construction are likely to support overwintering fish as well. Under-ice withdrawals from areas having water and dissolved-oxygen levels barely to moderately sufficient to support overwintering fish would be likely to kill many of the fish overwintering there. The recovery of affected fish populations would be expected in 5 to 10 years. However, withdrawals from freshwater sources that do not support resident fish populations, or from areas having sufficient under-ice reserves of water and dissolved oxygen, are not likely to adversely affect overwintering fish. Because 95 percent of the planning area is not overwintering habitat, and because Alternative B precludes any oil and gas activity in most of the planning area inhabited by fish, ice-road and airstrip construction and freshwater withdrawals during exploration are likely to occur in non overwintering areas of low- to no-fish density. Hence, these activities associated with Alternative B are expected to have no measurable effect on arctic fish populations in the planning area.

During production, drill pads, roads, and airstrips (if needed) would be constructed of gravel. While the planning area supports relatively large numbers of small, resident freshwater fish (e.g., ninespine stickleback), species diversity in most of the planning area typically is very low, and large resident fish often are absent. As discussed in Section III.B.2, this is due to inadequate overwintering, feeding, and spawning areas; the frequent inaccessibility of these areas to migratory species; or some combination of the above conditions. Pad and road construction in these low-density areas may kill some of the smaller resident fish in the immediate area, but most are likely to move into other areas during construction; and overall effects are expected to be insignificant. Construction in high-density spawning and overwintering areas, or in access corridors used by migratory fish, would be likely to adversely affect a relatively large number of freshwater and migratory fish. The probable results of these actions include the degradation or loss of overwintering habitat, partially blocked access to and from summer feeding and overwintering areas, and siltation in or near these habitats. The resulting effects on arctic fish are likely to be spawning failure and or mortality of many fish. Recovery would be expected in about 10 years. However, pad and road construction is likely to have no measurable adverse effect on arctic fish population (1) in low-diversity areas sparsely inhabited by large fish, (2) during times when migratory fish are not moving to and from freshwater, and (3) in such a manner that siltation is minimized and fish passage is not impaired.

During production, up to 75 mi of pipeline would be constructed under Alternative B. New pipelines constructed on land and around the shoreline of deeper lakes would be suspended on VSM's. Those crossing wide, deep rivers would be horizontally tunneled approximately 100 ft beneath the riverbed. Pipelines constructed in this manner are not likely to have an effect on arctic fish. New pipelines crossing wide, shallow rivers will be trenched and buried within the streambed during winter. Pipelines constructed in this manner could adversely affect fish if the trenching is done in or near overwintering or spawning habitats. Because overwintering and spawning habitats normally are located in deepwater environments, the trenching of shallow rivers during pipeline construction is not likely to adversely affect these habitats. If they were affected by trenching, the expected adverse effects would be the degradation or loss of overwintering and spawning habitat, resulting in spawning failure and mortality for many fish. Recovery would be expected in 5 to 10 years. Pipeline trenching through non-overwintering and/or spawning areas (>95% of the planning area) is not expected to have a measurable effect on arctic fish populations. Due to the relatively small number of pipeline miles associated with Alternative B, the small amount of overwintering and/or spawning habitat within the planning area, and the fact that Alternative B precludes any oil and gas activity in most of the planning area inhabited by fish, trenching for pipeline burial is expected to occur in areas of low- to no-fish density. Hence, pipeline construction associated with Alternative B is expected to have no measurable effect on arctic fish populations in the planning area.

Due to a lack of gravel resources within the planning area, gravel extraction for the construction of roads, pads, and airstrips is likely to occur outside of the planning area (i.e., east of the Colville River). However, there is a possibility that gravel extraction could also occur within the planning area. Gravel extraction from or near overwintering and spawning habitat is likely to adversely affect arctic fish by reducing the amount and quality of habitat available to them. Because overwintering and spawning habitat represents <5 percent of the planning area, gravel removal from these areas would be likely to result in spawning failure and mortality for many fish within the affected area. Gravel removal from non-overwintering or spawning areas of low resident fish density would be likely to have little to no adverse effect on arctic fish populations.

(2) Effects of Spills: The individual effects of oil on fish have been discussed in Alternative A. As discussed therein, lethal effects on fish due to a petroleum-related spill are seldom observed outside the laboratory environment. Sublethal effects are more likely and include changes in growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources; and consumption of contaminated prey. The specific effect of oil on fish generally depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive).

The oil-spill analysis estimates that 65 to 80 percent of the crude oil spills associated with NPR-A oil production would occur on a drilling-pad. Because drilling pad oil spills typically are small in size and easily cleaned up, they are not expected to come in contact with fish habitat and would have no perceptible effect on arctic fish. The oil-spill analysis also estimates that 20 to 35 percent of the oil spills would occur off drilling pads in the surrounding environment. More specifically, for Alternative B, the oil-spill analysis estimates that 76 percent of all oil spills would be <1 bbl, 19 percent would be between 1 and 5 bbl, 5 percent would be between 5 and 25 bbl, and the total amount of oil spilled during the entire production life of the field would be 280 bbl. While oil spills in the surrounding environment may adversely affect arctic fish in the immediate area, their small size is likely to preclude them from traveling far enough to get into large rivers and subsequently into coastal waters. Even if they did get into large rivers, their small size is likely to have no effect on arctic fish populations. Hence, no effects are expected on arctic fish populations in large rivers or coastal waters from oil spills associated with Alternative B. Some fish in the immediate area of an oil spill may be lethally or sublethally affected, particularly if the spill occurred where and when fish are migrating, in overwintering areas during winter, or in small waterbodies having restricted water exchange. However, due to the small size of the oil spills anticipated, the low diversity and abundance of fish in most of the planning area (particularly large resident fish), the unlikelihood of spills blocking fish migrations or occurring in overwintering areas, and the fact that Alternative B precludes any oil and gas activity in most of the planning area inhabited by fish, oil spills associated with Alternative B are expected to lethally or sublethally affect a small number of the arctic fish in the planning area over the production life of the field. Recovery from each spill affecting fish is expected within 3 years.

Conclusion—First Sale: Based on the discussion in the text, fuel spills associated with Alternative B are expected to have a similar effect on arctic fish populations as discussed for Alternative A. Seismic surveys and construction related actions are expected to have no measurable effect on arctic fish populations in the planning area. Oil spills are expected to lethally or sublethally affect a small number of fish in the planning area over the production life of the field. Recovery from each spill affecting fish is expected within 3 years.

Multiple Sales: While additional lease sales in the planning area would involve more seismic surveys than the first sale, and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Seismic surveys associated with multiple sales in Alternative B are expected to have the same overall effect on arctic fish populations as discussed for the first sale (i.e., no measurable effect on arctic fish populations). For additional sales in the planning area, the number of production pads and pipeline miles are estimated (Table A.2-8) to be about twice the number of gravel pads as the first sale (Table A.2-6). Gravel pads for multiple sales are likely to have about twice the effect on arctic fish as the first sale. Because there is little difference in the estimated number of pipeline miles for multiple sales (up to 90) and the first sale (up to 75), they are expected to have a similar effect as discussed for the first sale. It is estimated that up to 400 bbl of crude oil would be spilled, or about

1.4 times that of the first sale (estimated at up to 280 bbl). On the basis of this estimate, crude oil spills for multiple sales are expected to have a slightly greater effect on arctic fish populations than the first sale. However, if there were not enough time between sales to allow for full recovery, or if the level of activity of the selected alternatives is significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations is likely to be greater than estimated herein for multiple sales.

Conclusion—Multiple Sales: Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish populations as the first sale. Gravel pads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.

Effectiveness of Stipulations: Stipulations 15, 16, 20, and 39 through 42 are the most likely to have a beneficial effect on arctic fish. Others that may benefit arctic fish include Stipulations 5, 9, 11, and 12. With these stipulations in place, there is an increased probability that (1) spawning and overwintering fish would be unaffected by construction-related actions, (2) fish passage and streamflows would be maintained, and (3) the effects of accidental oil and fuel spills would be minimized. To the degree they are implemented, these stipulations are expected to benefit arctic fish populations. However, because there is relatively little activity associated with Alternative B that may affect arctic fish, their absence is not expected to measurably increase adverse effects on arctic fish populations.

8. Birds:

This section discusses potentially adverse effects of ground- impacting-management actions on nonendangered birds within the planning area under Alternative B. Such actions, including oil and gas exploration and development, potentially may result in disturbance factors, habitat alteration or loss, and fuel or oil spills. Effects on birds exposed to such results would be similar to those discussed under Alternative A, with the addition of habitat loss and oil-spill effects specifically associated with oil and gas activities.

a. Activities Other than Oil and Gas Exploration and Development:

Management actions for activities other than oil and gas exploration and development under Alternative B, and their potential effects, differ from those discussed for Alternative A as follows:

1. The Colville River would be recommended for designation as a "wild" river in the WSR System, with stipulations protecting existing wild values. Most importantly, in the riparian corridor area: (a) flood-control development and major diversions are prohibited; (b) mineral leases within ¼ mi are prohibited and mining activities should be conducted to minimize surface disturbance, sedimentation, and pollution; (c) roads/trails for motorized travel, and most motorized travel would be prohibited (possible exceptions); (d) major public use areas/facilities are prohibited; (e) designation of new rights-of-way (e.g., pipeline) is discouraged.

2. A portion of the Colville River Raptor, Passerine, and Moose Area LUEA would be proposed as a Bird Conservation Area.

3. There would be no surface occupancy for industrial development within 1 mi of the Colville, Kogosukruk, or Kikiakrorak rivers. Any of these actions that are successfully concluded or stipulated may enhance raptor and passerine habitat protection along the rivers and potentially decrease the level of noise and visual disturbance of nesting birds. However, recreational boating would be encouraged, potentially increasing visitation and associated disturbance and/or habitat degradation in this area (estimated increase above Umiat, 15 parties [Alt. A = 9]; below Umiat, where most raptor nesting occurs, 15 parties [A = 5])—this could partially offset reduction of such effects from this and other factors (e.g., overland motorized travel) by stipulation. As a result, the effect of visitation on breeding success of raptors (or passerines) is expected to increase from that discussed under Alternative A, but information that would allow quantified predictions is lacking; presumably effects could include nest abandonment, interruption of incubation or brooding, and/or decreased provisioning of young, any of which could result in lower productivity.

4. Some ground activities are focused on the central and southern planning area where lower densities of most waterbirds, but not Pacific loon, oldsquaw, scaup, scoters, and jaegers, are found; however, such activities are expected to occur at scattered localities, and thus effects are likely to be similar to Alternative A, a minor loss of productivity.

5. Some ground activities (surveys) and presence of camps would be prolonged two to four times as long as under Alternative A, but this is not expected to significantly increase the extent of displacement, predation by attracted predators, or minor declines in productivity by local bird populations, which may not be detectable above the natural fluctuations of the population and survey methods/data available.

6. Aircraft activities (transport, surveys) would be regular rather than occasional and continue for longer periods (up to 3 weeks) than under Alternative A (Table II.H.3.b). As a result, effects of aircraft traffic on breeding success of various species and/or survival of molting geese are expected to increase from those discussed under Alternative A, but information that would allow quantified predictions is lacking. Presumably, they could include nest abandonment, interruption of incubation or brooding, and/or decreased provisioning of young and, potentially, adverse energetic responses by molting geese, which could result in lower productivity by breeding birds or survival of molting geese. These effects are not expected to be significantly greater than under Alternative A, but lost productivity of breeding birds and decreased survivorship of molting birds may not be detectable above the natural fluctuations of the population and survey methods/data available.

b. Oil and Gas Exploration and Development Activities: Oil and gas leasing would be allowed on approximately 44 percent of the planning area (Fig. II.C.1-2 Table IV.A-1), including lands outside the LUEA's (these may be crossed by pipelines) and in the Kuukpik Corporation Entitlement LUEA near Nuiqsut (Sec. II). Infrastructure and associated construction required for development and production is expected to be substantially greater than that for exploration; two approximately-10-acre production pads separated by about 3 mi of connecting road/airstrip, and pipeline system for oil transportation. Exploration would occur during the winter season for up to 10 years and involve about 60 persons, while development and production activity would be year-round for 2 to 5 years and require about 350 persons during the construction phase. Potential effects of disturbance, habitat alteration or loss, and oil pollution are discussed in USDOI, MMS (1996a), which is incorporated by reference and summarized below.

(1) Effects of Disturbance: Noise from human activities, as well as visual presence of humans and/or equipment and facilities, may disturb birds during any phase of the annual cycle; birds are particularly sensitive when attending a nest, accompanying fledged young, or in a flightless molt condition. Disturbance may cause individuals to abandon local nesting, feeding, broodrearing, molting, or staging areas to expend energy stores essential for completing the annual cycle and to experience higher rates of predation by predators attracted to facilities, all of which may contribute to decreased productivity, survival, and/or recruitment. Habitat alteration or loss may result in many of these same effects. Potentially disturbing activities include seismic surveys, aircraft operations, marine-vessel traffic, drilling operations, construction activities, vehicle traffic, oil-spill-cleanup operations, and movement of personnel near facilities.

(a) Effects from Seismic Surveys: It is assumed that seismic surveys will occur during winter months (December-April), when nearly all birds are absent from the region. Effects of seismic surveys are expected to be as discussed for Alternative A (brief, <1 day, local disturbance and no significant population effect). Use of a more tightly spaced 3-D seismic grid (Sec. IV.A.1.c) potentially may cause ptarmigan, gyrfalcons, or snowy owls to vacate a 10 by 15 mi (16 x 24 km) area for the winter season (1+ mi^2 surveyed/day), a more significant result than typical seismic operations but still expected to cause minor local rather than population-level effects.

(b) Effects from Aircraft Operations: Oil and gas activities in the planning area will be supported primarily by fixed-wing aircraft, with helicopters used mainly for emergencies and pipeline inspection.

Under this alternative oil and gas activities would occur only in approximately the southern half of the planning area as indicated above. Because one flight every other day would be required to service either seismic or exploration-drilling operations, the potential level of disturbance may be greater near a single exploration pad than at each succeeding seismic location. Potential effects of this activity could range from minor temporary (<1 day) behavioral alterations or displacement in a few ptarmigan, gyrfalcons, or possibly snowy owls near survey gridlines or drill-sites, to avoidance of the immediate area of routinely used airstrips for the winter season. No population- level effects are expected.

If a commercial oil discovery is made, drilling operations and associated activities supported by aircraft may occur throughout the year, with one to two flights/day anticipated at up to four sites. The overall impact of aircraft would depend on the character of the operations—type of aircraft, flight frequency, altitude, lateral distance to individuals, route used, season of operation—and the sensitivity of the population segment exposed to characteristics potentially causing disturbance. If aircraft supplying or operating out of these sites overfly bird-concentration areas routinely, an adverse noise/visual aspect to the environment could be introduced potentially causing abandonment of nesting efforts or lower survival of young in the vicinity, and may contribute to avoidance of the immediate area for future nesting attempts. One or more high-density-concentration areas of 0 to 6 of 12 species (substantial areas for pacific loon, yellow-billed loon, tundra swan, king eider, oldsquaw, scoters, jaegers) recorded on waterfowl breeding-pair surveys are located within the area proposed for oil and gas leasing (Fig. III.B.4-1); areas where several species reach high density occur north and south of Nuiqsut and in the east-central portion of the planning area.

Lateral distance at which observable responses occur or percent individuals responding have been quantified for few species: twin engine fixed-wing aircraft (e.g., twin otter) approaching within 0.6 mi (1 km) of nesting snow geese on Howe Island east of Prudhoe Bay elicited minor responses of alert posture and short movements in 9-57 percent of individuals (Burgess and Ritchie, 1989); most (81-100%) Canada, greater white-fronted, and snow geese in the Lisburne area at Prudhoe Bay showed no reaction when approached within 0.3 mi (0.5 km); most brant (84%), a more sensitive species, moved away from their position under the same circumstances (Murphy, et al., 1990); at Izembek Lagoon, 31, 73, and 79 percent of staging Canada, emperor geese and brant, respectively, responded to similar test conditions (Ward and Stehn, 1989). As a result of these levels of response to aircraft, nesting activity for most waterfowl is expected to variably decrease within 0.3 to 0.6 mi (0.5-1 km) of any corridor used by routine air traffic, especially under takeoff and landing corridors near the facility, for the duration of each well drilled (approximately 3 months), and subsequent maintenance activity. Estimated numbers of individuals exposed along such a corridor, for example, could include 1 to 11 yellow-billed loons, 0 to 20 king eiders, or 5 to 358 oldsquaw, depending on the specific facility location. Low-level pipeline-inspection flights are expected to displace a small number of nesting attempts away from the immediate vicinity of a pipeline for < 1 day. Overall effect of aircraft operations on bird populations at such sites is expected to be localized displacement and minor decrease in reproductive success, but any lost productivity or recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available.

(c) Effects from Vessel Operation: Some heavy equipment, supplies, or gravel may be transported by barge from existing infrastructure to coastal staging areas during the open-water season, but the probability of interaction with eiders, oldsquaw, or other waterfowl staging in lagoon or offshore waters, or broodrearing geese in coastal fringe areas, is considered low. No species is expected to experience significant displacement from foraging areas as a result of exposure to vessel traffic.

(d) Effects from Drilling Activities: Noise and activity associated with exploration drilling in winter potentially could displace small numbers of ptarmigan from within an estimated 700 ft (213 m) of the site, and any gyrfalcons and possibly snowy owls present may be displaced 0.6 mi (1 km) or more by the activity. Because such sites would affect a small area (3-10 acres), there is not expected to be a significant population effect. If a commercial discovery is made, noise and activity of summer drilling may disturb a small number of nesting and or molting waterfowl or other species within a kilometer of the activity. Data obtained in the vicinity of oilfield facilities in the Prudhoe Bay area indicate that spectacled eiders, for example, are quite tolerant of noise and activity (TERA, 1996). Some localized displacement of nesting birds from the vicinity of such sites may occur, but significant affects on reproductive success are not expected.

(e) Effects from Construction Activities and Vehicle Traffic: No construction activities are expected to occur in marine areas, so no effects on birds occupying marine habitats are anticipated. Onshore construction likely will occur in winter and result in effects similar to those caused by drilling. If development and production occur, vehicle traffic on roads connecting drill pads in the oilfield is expected to result in minimal displacement of nesting birds from within an estimated 700 ft to 0.6 mi (213 m-1 km) of routinely used roads, depending on tolerance to noise and activity of potentially affected species. Summer traffic will be limited to transport and maintenance within the fields, because no road access to the oilfields from existing systems is planned. Gravel extraction is expected to take place primarily at permitted areas east of the planning area and be transported to pad- and pipeline-construction sites via ice road in winter, causing effects similar to those discussed for seismic activities—displacement of winter-resident birds from within 700 ft to 0.6 mi (213 m-1 km) of roads and storage sites.

(f) Effects from Spill Cleanup: No spills are expected to occur in marine areas, and no effects on birds occupying marine habitats are anticipated. Approximately 65 to 80 percent of onshore crude-oil spills averaging 4.0 bbl occur on pads and are contained before entering the surrounding area; thus, most potentially disturbing cleanup activity would be confined to the immediate pad area. Because routine activities occurring on the pad during the breeding season are likely to have displaced sensitive species at least several hundred feet (a few hundred meters) away from the pad area, the incidental spill-cleanup activity is expected to cause minimal additional disturbance effect among remaining birds nesting, broodrearing, or molting in the pad vicinity—potentially a few clutches or broods could be lost to predators if adults are disturbed and leave the nest unprotected, but the most likely effect would be brief behavioral responses. Mueller (1997, pers. comm.) reports that a pipeline spill on December 30, 1993, at drill site 5, well 23, misted a fine oil spray over a tundra area of 100 to 145 acres. Of the off-pad spills that occur, many contact snow, which is cleaned up before the oil reaches the tundra. The ADEC database documents that a spill at Point McIntyre covered approximately 23 acres of snow-covered tundra with 142 bbl of crude oil. Because this area was snow covered, there was little impact to the surrounding environment. If this spill occurred during the summer, the impacts would have been very different. Any spills that reach the surrounding environment may spread more widely, especially if aquatic habitats are involved, and require greater cleanup effort that may cause more widespread disturbance effects.

(g) Effects from Predator Attraction: The attraction of predators on birds (glaucous gull, common raven, arctic fox, grizzly bear) to uncontained refuse is well known. The extent to which attractant conditions would occur at the proposed facilities is unknown, and is expected to be closely regulated. Although some studies have demonstrated a high correlation between presence or absence of predators and reproductive success, it is uncertain in most instances what effect predation by these species has on overall reproductive success and local population trends. Nor is it certain if predator populations with access to refuse are higher than they would be in its absence. Fox and gull predation on island-nesting species or those that are colonial has been implicated in nest losses ranging from substantial to total failure (e.g., snow goose, Burgess and Rose, 1994; Johnson and Noel, 1996; common eider, Quinlan and Lehnhausen, 1982). Several studies have correlated nest success with fox predation pressure (e.g., brant and shorebirds, Underhill et al., 1993). Oil and gas development and production facilities could attract all four species if conditions are not closely controlled, but this is not expected to cause other than local concentration of predators affecting local breeding success. The extent of any effect is not known but could involve any of the species likely to occur in the planning area. Overall effect on populations is not expected to be detectable above the natural fluctuations of the population and survey methods/data available productivity and recruitment lost from the local area.

(2) Effects of Habitat Alteration and Loss: Habitats underlying ice pads and roads are temporarily altered/lost for bird use as a result of delayed thaw, soil compaction, and vegetation disturbance. In the summer following pad/road use delayed melt would make the area unavailable until after most species begin nesting. This would be expected to affect species with strong nest site fidelity (e.g., shorebirds, ptarmigan), although most displaced individuals are expected to use other available habitat in the vicinity (Troy and Carpenter, 1990). Compaction of soil and vegetation (decreased concealment) or drainage effects (Sec. III.A.2.a) could persist for a longer period. Pads range from 3 to 10 acres and roads from 5 to 6 acres/mi; the length of road required is unknown at present, but several hundred acres in the planning area could be unavailable for a season, with some degradation persisting several years. For example, an ice road from the planning area boundary to an exploration site south of Teshekpuk Lake might remove 370 acres, equivalent to 0.008 percent of the planning area. Areas subject to such minor disturbance are expected to recover almost fully within a relatively few years (Jorgenson and Joyce, 1994) and to support the original plant and animal communities. Effects on bird productivity are expected to be minor, because adjacent undisturbed habitat would be available for most species, and recovery of the area would be relatively rapid.

Gravel pad, road, and airstrip construction and gravel mining would result in loss of habitat for the duration of production; this alteration would be permanent unless restoration is completed successfully. Current techniques are expected to restore such areas to usable habitat, but rarely would they duplicate the original habitat characteristics (Jorgenson and Joyce, 1994). As the most abundant habitat types, tussock tundra, dwarf shrub, and moist sedge-grass meadow probably are the habitats that would be most affected, but the proportion lost would be small relative to their abundance. Although placement of gravel structures will be long-term and habitat alteration severe, because displaced individuals are likely to use adjacent undisturbed habitats (Troy and Carpenter, 1990), and the area involved is relatively small (<60 acres, <110 acres if gravel must be mined locally), effects on productivity are expected to be minor.

Habitat use by birds may be altered along roads and other structures by dust fallout, gravel spray, snow accumulations, thermokarst, impoundments, water withdrawal, and contaminants; habitat fragmentation from road networks also may affect use. Dust fallout effects would be most pronounced within 35 ft of the source (ARCO, 1996); this would approximate 34 acres at the expected facility (Fig. IV.A.1.b-1). The principal effects of dust fallout would include advanced snowmelt (up to 2 weeks early); increased depth of thaw; thermokarst; reduced plant photosynthesis; decreases in some common moss, lichen, and shrub species; and development of barren areas (Everett, 1980; Klinger, Walker, and Weber, 1983; Walker, Lederer, and Walker, 1985; Walker and Everett, 1987). Early melt provides waterfowl and ptarmigan prenesting access to exposed forage (Murphy and Anderson, 1993), but also exposes them to risk of vehicle strikes. Likewise, shorebirds may be attracted to areas adjoining light-traffic roads because of earlier availability of nesting habitat in combination with an acceptable level of disturbance (Troy, 1988, 1993).

Thermokarst from surface disturbance may result in enhanced growth and nutrient concentration in forage plants, which might be expected to attract birds, but the evidence appears insufficient to assess the net effect on populations (Truett and Kertell, 1992). Water temporarily impounded by roads and pads, in combination with early habitat availability caused by dust fallout and delayed availability due to persistent snowdrifts resulting from differing traffic levels, has been found to attract some shorebird species while others are found in lower densities than in undisturbed areas (Troy, 1986). For example, Troy (1993) in an extreme case found habitat use by semipalmated sandpipers along a heavily traveled road at Prudhoe Bay reduced 40 percent from that in an undisturbed area. Water withdrawal from lakes could alter the local hydrologic regime resulting in less suitable habitat for some species but more favorable for others, e.g., dominant nesting species in such an area could change from red phalarope with preference for wetter habitat and access to open water, to pectoral sandpiper preferring drier habitat. The potential field layout (Fig. IV.A.1.b-1) does not appear to cause habitat fragmentation as occurred with road networks in the Prudhoe Bay area. In any case, Troy (1993) found little support for the hypothesis that fragmentation affects bird use of areas surrounded by oilfield facilities.

There is little doubt that bird use of habitats is altered when these are near roads and pads, and that effects vary among species and phase of the summer season. However, potential facility size and design suggests that only a small amount of habitat will be altered by proposed oil and gas development resulting in no greater than minor effects on local bird populations.

(3) **Effects of Spills:** It is assumed that no crude oil would be released during exploration. No spills are expected to occur in marine areas, so any spills contacting birds occupying marine habitats are likely to originate on land, either runoff from pads/roads or at pipeline river crossings. Approximately 65 to 80 percent of onshore crude-oil spills, averaging 4.0 bbl, occur on pads where they are contained before entering the surrounding area; thus, a substantial proportion of spills are not expected to adversely affect bird populations. Probability of exposure and species exposed to the 20 to 35 percent of spills that occur on or reach tundra habitats would depend on the season of occurrence and, if occurring in the open-water season, whether they enter nonaquatic or aquatic habitats. Spills reaching nonaquatic habitats generally remain in limited areas (<538 ft^2 = 50 m^2), and the small volume likely to be spilled suggests that only a few foraging or broodrearing shorebirds or passerines potentially would contact the oiled area; population effects under these circumstances are expected to be insignificant and are not likely to be detectable above the natural fluctuations of the population and survey methods/data available.

Birds exposed to spilled oil in aquatic habitats are not expected to survive moderate to heavy contact. Oil ingestion may reduce breeding success and causes various pathological conditions including impaired endocrine and liver function and reduced nestling growth (Burger and Fry, 1993; Harvey, Phillips, and Sharp, 1982; Holmes, 1985; Holmes and Cavanaugh, 1990; Hughes, Kassera, and Thomas, 1990; Koth and Vank-Hentzelt, 1988; Peakall et al., 1980; Stubblefield et al., 1995). Oil contamination of eggs by adults significantly reduces hatching success (Albers, 1980; Butler, et al., 1988; Harfenist, Gilman, and Maus, 1990; King and Lefever, 1979; Stickel and Dieter, 1979). In addition, oil in tundra ponds can have long term effects on invertebrate prey populations and emergent vegetation thereby reducing food availability and escape cover for waterbirds in the area impacted by the spill (Barsdate et al., 1980; Hobbie, 1982). The occurrence of these effects may be increased by contamination of food, lakeshores, and marine shorelines. At greatest risk would be loons and waterfowl occupying open waterbodies or streams, especially molting geese. However, the small average spill volume suggests that only a small proportion of the surface of any but the smallest lakes (<1.2 mi^2 = 3 km^2) would be covered by oil, and most small lakes typically have <100 individuals; in these situations, contact is expected to be on the order of tens of individuals. A larger spill entering a larger lake (<7.7 mi^2 = 20 km^2) with a more substantial molting population could result in greater losses, depending on the location of geese in relation to oil entry and direction and velocity of wind driving the slick, on the order of hundreds of individuals; in either case, losses may not be detectable above the natural fluctuations of the population and survey methods/data available. Spills entering streams or rivers during the breeding season could contact waterfowl adults and/or young. Oil entering coastal lagoon habitats occupied by broodrearing or staging waterfowl (e.g., oldsquaw) potentially could contact substantial numbers of individuals, but the small estimated average spill size suggests that only minor contact and effect would be expected.

Because spills of refined oil products (primarily fuels and lubricants) are likely to occur on pads or roads where they can be contained and removed, and the small estimated average spill volume (0.7 bbl), significant exposure of birds is not expected to occur.

Summary: Effects of ground-impacting management actions under Alternative B will be similar to those discussed for Alternative A, with differences as follows: The Colville River would be recommended for designation as a wild river in the WSR System, with stipulations protecting existing wild values. A portion of the Colville River Raptor, Passerine and Moose Area LUEA would be proposed as a Bird Conservation Area. Either of these actions may enhance raptor and passerine habitat protection along these rivers and potentially decrease the level of noise and visual disturbance. However, increased boating recreation and associated disturbance and habitat degradation in these areas also is expected. As a result, visitation effects on raptor (or passerine) nesting success are expected to increase from Alternative A, but information that would allow quantitative predictions is lacking. Most ground activities are likely to occur at scattered localities with effects similar to Alternative A, minor loss of productivity. Some surveys and presence of camps would occur over intervals 2 to 4 times as long, but this is not expected to significantly increase displacement of individuals, predator attraction, or minor declines in productivity by local populations, or the estimated time required (<1 year) for recovery of lost productivity. Aircraft activities would be more regular and surveys would continue for longer periods; as a result, effects of air traffic on breeding success of various species and /or survival of molting geese are not expected to increase significantly from Alternative A, but are not likely to be detectable above the natural fluctuations of the population and survey methods/data available.

Oil and gas leasing would be allowed on approximately the southern half of the planning area. Exploration would occur in winter, development and production year-round. A production facility may consist of two 10 acre production pads connected by a 3 mi road/airstrip, and a pipeline for oil transport. Disturbance from human activities, presence and/or equipment and facilities may cause individual birds to abandon local nesting, feeding, broodrearing, molting, or staging areas, to expend extra energy, and to experience higher rates of predation, all of which may contribute to decreased productivity, survival, and/or recruitment. Habitat alteration or loss may cause similar effects.

Ground effects of winter seismic surveys are similar to Alternative A: brief (<1 day) minor disturbance of local ptarmigan, gyrfalcons, or snowy owls. Air support operations primarily would involve fixed-wing aircraft. Air support of winter seismic or exploration-drilling operations could range from minor, <1 day behavioral alterations or displacement of ptarmigan, gyrfalcons, or snowy owls present, to avoidance of routinely-used airstrip areas for the winter season. Air support of development and production activities would involve 1 to 2 flights/day year-round. Routine overflight of bird concentration areas could cause abandonment of nesting efforts or lower survival of young in the vicinity. Disturbance studies suggest that breeding or staging geese will exhibit highly varying responses to aircraft approach. Based on these results, in general nesting activity of most waterfowl is expected to variably decrease within 0.3 to 0.6 mi (0.5-1 km) of any corridor used by routine air traffic for the duration of each well drilled and subsequent maintenance activity. Overall effect of aircraft operations on bird populations in the vicinity of drill sites are expected to be localized and minor, requiring <1 year for replacement of any lost productivity or recruitment. No species is expected to experience significant displacement from vessel traffic. Drilling activity is expected to cause displacement of birds from within 700 ft to 0.6 mi (213 m-1 km) of the site, but no significant effects on breeding success. Onshore construction and gravel extraction is expected to result in effects similar to winter drilling. Vehicle traffic is expected to cause minor displacement of birds from within an estimated 700 ft to 0.6 mi (213 m-1 km) of routinely used roads. Cleanup of spills reaching off-pad areas after nesting has begun is expected to displace a small number of breeding birds with a few clutches or broods lost to predation while adults are absent. The effect of potentially increased predation by predators attracted to work sites is expected to require <1 year for recovery of productivity and recruitment lost from the local area.

Birds temporarily excluded from habitats underlying ice pads and roads are expected to use other undisturbed habitat in the vicinity. These will represent a small proportion of the planning area and the effect on bird productivity is expected to be minor. Gravel pads, roads, airstrips, and mine sites also are expected to have a minor effect on productivity because displaced individuals are likely to use adjacent undisturbed habitats, but the effect will extend beyond the termination of production. Bird use of habitats near roads and pads is altered as a result of the effect of dust fallout on snowmelt and other habitat characteristics, and alteration of local hydrology. However, potential facility size and design suggests only a small amount of habitat will be altered, with no more than minor effects on local bird populations.

No oil spills (average estimated volume = 4 bbl) are expected to occur during exploration or in the marine environment. A spill reaching nonaquatic habitats is expected to affect only a small area and a few shorebirds or passerines, requiring <1 year to recover any lost productivity or recruitment. If a spill reaches an aquatic habitat, loons and waterfowl are at greatest risk of oiling; however, the small average spill volume suggests only a small proportion of the surface of any but the smallest lakes would be covered, so relatively few individuals are expected to be contacted. Losses of tens of individuals may be replaced within 1 year.

Conclusion: Under Alternative B, most disturbance effects not associated with oil and gas activities are expected to be similar to those discussed for Alternative A, although lost productivity of nesting species and decreased survivorship of molting birds may not be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect of aircraft operations supporting oil and gas activities, and most other activities causing disturbance, on productivity or recruitment of bird populations in the vicinity of drill sites is expected to be localized and minor, but likewise may not be detectable above the natural fluctuations of the population and survey methods/data available. Losses attributed to predators attracted to sites may be substantial but is difficult to quantify. Displacement of nesting birds from gravel structures and pits is expected to have primarily minor local effects on productivity because displaced individuals are likely to use adjacent undisturbed habitats. As a result of their small average size, oil spills reaching aquatic habitats are expected to cause losses of tens of individuals, but the effect of such losses may not be detectable above the natural fluctuations of the population and survey methods/data available.

Multiple Sales: If multiple sales occur in the area available for leasing under Alternative B, intensive construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Approximately four times the number of exploration wells may be drilled (1-4 v. 4-14), and the number of fields developed (0-1 v. 0-2) and production pads (0-2 v. 0-4) are expected to double, with multiple sales. Pipeline mileage (0-75 mi) is expected to increase to 0 to 90 mi. Surface, air, and foot traffic are expected to increase somewhat near oilfield facilities with multiple sales, and to displace greater numbers of individuals and involve more species than with a single sale, though the increase is not expected to significantly affect populations. Effects from disturbance and habitat alteration or loss on birds is expected to increase in the southern half of the planning area with multiple sales under Alternative B.

The estimated number of onshore oil spills >1 bbl is expected to increase from 0 to 17 under the first sale to 0 to 25 with multiple sales (average size 4 bbl), and from 0 to 162 small refined-oil spills under the first sale (average size of 29 gal) to 0 to 232 with multiple sales over the production life of the planning area (Tables IV.A.2-3a, IV A2-3b, IV A 2-6a and IV A 2-6b). These small, chronic spills are expected to have a similar effect on birds and their habitats as under Alternative B with the first sale but with increased numbers of species involved and increased loss of individuals; habitat contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect populations significantly.

Conclusion—Multiple Sales: Displacement of birds from disturbance and habitat alteration is expected to increase in the southern half of the planning area under Alternative B with multiple sales, but not significantly affect coastal plain populations. Increases in oil and refined oil spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect is expected to increase somewhat from that discussed for the first sale.

Effectiveness of Stipulations: Subject to several exemptions noted in Section II.C.7, the proposed stipulations are expected to have the following effects.

Disturbance of birds from ground transport and other activities including oil and gas activities would be mitigated, and essential habitat protected, by: (20b-d, g-m; 50a, d; 77) minimizing and seasonally restricting offpad activities in Goose Molting LUEA, traffic volume and vehicle use/speed, seismic activity, and taking recommended precautions in Goose Molting and Colville River LUEA's (loons, waterfowl, shorebirds, raptors, passerines affected); (25) placing permanent facilities outside a 1,640-ft (500 m) buffer around all goose-molting lakes and 3,280 ft- (1,000 m) buffer around high-use lakes (loons, waterfowl, shorebirds); (13c) not disposing of domestic wastewater into freshwater; (17) not removing water from lakes in the Goose Molting Habitat if it would adversely affect lakeshore goose-feeding habitats (loons, waterfowl, shorebirds); (14, 34) offsetting ice road location annually, and seasonally restricting major construction in the Goose Molting LUEA (loons, waterfowl, shorebirds); (39, 40, 41,43, 45, 48, 70) establishing facility setbacks along specified lakes and streams, facilities and mining sites located out of floodplains and 500 ft (152 m) from lake basins, maintaining natural drainage patterns during and after construction, prohibiting most surface structures in the Colville River Raptor, Passerine, and Moose LUEA, and minimizing impacts on key wetlands (loons, waterfowl, shorebirds, raptors, passerines); (59) sites rehabilitated when abandoned. Aircraft disturbance of birds would be mitigated by: (54, 55, 56, 57) seasonal restriction of helicopter flights in the Goose Molting LUEA, maintenance of seasonal minimum air traffic volume in and flight altitudes over the Teshekpuk Lake Caribou and Goose Molting LUEA's, and within ½ mi of peregrine falcon nests, prohibiting use of aircraft to haze birds (loons, waterfowl, shorebirds, raptors, passerines).

Potentially adverse situations involving hazardous materials and wastewater would be mitigated by: (5, 8) immediate cleanup of fuel spills and other hazardous materials using procedures approved by USEPA, ADEC, and OSHA, and materials stored at all fueling and maintenance areas; (9, 11, 12) storing fuels in lined/diked areas at least 500 ft (152 m) from lakes and streams, not storing fuels on lake or river ice, and not refueling equipment within 500 ft of lakes or streams (loons, waterfowl, shorebirds, passerines).

Other potentially adverse situations would be mitigated by: (1, 75) taking precautions to avoid attracting wildlife (predators) to refuse, and prohibiting the feeding of birds (most birds); (65) requiring all personnel to participate annually in an orientation program that aquaints them with biological resources and their sensitivity to disturbance and habitat degradation; (67) requiring all visitors to adhere to the applicable stipulations.

These stipulations would minimize disturbance from most factors, prevent fuel or oil spilled on pads from reaching surrounding habitats, and help prevent pollution and degradation of critical wildlife habitats.

9. Mammals:

a. Terrestrial Mammals: Among the terrestrial-mammal populations that could be affected by ground-impacting-management actions under Alternative B are caribou of the Teshekpuk Lake Herd (TLH) and the Central Arctic Herd (CAH). Caribou of the Western Arctic Herd (WAH) are not expected to be significantly affected, because their calving range is located far to the west of the planning area (Fig. III.B.9.a.-1). Some caribou of the WAH may be temporarily exposed to helicopter traffic and other human activities associated with resource inventories and seismic operations, but such exposure is not expected to have any effects on the population. Moose, muskoxen, grizzly bears, wolves, wolverines, and arctic foxes may be locally affected by planning-area activities.

(1) Activities Other than Oil and Gas Exploration and Development: Air traffic, humans on foot, and the presence of resource-inventory-survey camps are expected to increase somewhat under Alternative B are compared to Alternative A. Aircraft traffic associated with resource inventories and surveys is expected to pass overhead of caribou and other terrestrial mammals once during any flight to or from the camps and along aerial-survey routes. The disturbance reactions of caribou and other terrestrial mammals are expected to be brief, lasting for a few minutes to no more than 1 hour. Terrestrial mammals may avoid inventory-survey camps as well as recreation camps during the 4 to 6 weeks of activities.

(2) Oil and Gas Exploration and Development Activities: Under Alternative B, zero to one oilfield is assumed to be discovered and developed. Primary effects on terrestrial mammals would come from motor-vehicle traffic within the oilfield. Some effects also would come from humans on foot near facilities and camps; from aircraft traffic; from seismic operations; from small, chronic, crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and from habitat alteration associated with gravel mining and with construction of within-field gravel roads, pads, and other production facilities.

(a) Overview of the Effects of Disturbance: In the following discussion, the planning area is divided into thirds—northern (including Teshekpuk Lake and the Beaufort coast), middle (the area generally west and southwest of Nuiqsut), and southern. Under Alternative B, the southern and portions of the middle planning area are available for leasing and development (Fig. II.C.1-2).

If a field is developed in the middle planning area, effects on TLH caribou are likely to be small. Production facilities would be located far to the south of the TLH calving range, little or no effect on caribou movements within the range is expected, and no TLH calving is expected to be displaced. Some TLH migration movements and winter range may be adversely affected by air and surface traffic along pipelines and roads within the oilfield.

If a field is developed in the southern planning area, development would not include calving habitats of any of the Arctic caribou herds. Some members of the CAH, WAH, and TLH would encounter the field along their fall migration route and within a portion of their winter range. Development in the southern planning area would not be expected to significantly affect caribou movements nor significantly affect their distribution or abundance.

A pipeline from the oilfield would connect to the TAPS through facilities at the Alpine and Kuparuk River fields. The pipeline would be constructed during winter using ice roads; no permanent road would be associated with the pipeline. During construction, air traffic would include several flights per day, which temporarily could disturb some of the caribou of the TLH, CAH, and WAH and other terrestrial mammals within about 1.2 mi (2 km) of the pipeline. Disturbance and habitat effects on caribou and other terrestrial mammals are expected to be short term, interference with mammal movements would be temporary (probably a few minutes to less than a few days), and the mammals would eventually cross the pipeline area. Additionally, disturbance reactions would diminish after construction, and flights would decrease to about 1 to 2 per day at most. If aircraft were to maintain an altitude of 2,000 ft (about 600 m) during the caribou calving and postcalving seasons and an altitude of 1,000 ft (300 m) during other times of the year, disturbance of caribou could be avoided (Shideler et al., 1986). The abundance and overall distribution of terrestrial mammals are not expected to be affected by pipeline construction or operation.

343

(b) Effects of Disturbance by Species:

1) Effects on Caribou:

Exploration: Exploration will occur primarily during winter and potential disturbance primarily would come from aircraft traffic and seismic operations. Caribou have been shown to exhibit panic or violent flight reactions to aircraft flying at elevations of < 162 ft (< 60 m) and to exhibit strong escape responses (animals trotting or running from aircraft) to aircraft flying at 150 to 500 to 1,000 ft (300 m) (Calef, DeBock, and Lortie, 1976). However, these documented reactions were from aircraft that circled and flew over caribou groups repeatedly. Aircraft traffic associated with oil exploration is expected to pass overhead of caribou once during any flight to or from the exploration camps, and the disturbance reactions of caribou are expected to be brief, lasting for a few minutes to no more than 1 hour.

Development: Although much construction will occur primarily during winter, development will bring year-round facilities and activities to the caribou range. Caribou can be disturbed by ground vehicles, humans on foot, and low-flying aircraft associated with oil development (Calef, DeBock, and Lortie, 1976, Horejsi, 1981; Shideler, 1986; Tyler, 1991). The response of caribou to potential disturbance is highly variable—from no reaction to violent escape reactions—depending on their distance from human activity; speed of approaching disturbance source, frequency of disturbance; sex, age, and physiological condition of the animals; size of the caribou group; and season, terrain, and weather. Caribou cow and calf groups appear to be the most sensitive to traffic, especially in early summer during and immediately after calving, while bulls appear to be least sensitive all year.

Tolerance to aircraft, ground-vehicle traffic, and other human activities has been reported in several studies of caribou and other hoofed-mammal populations in North America (Davis, Valkenburg, and Reynolds, 1980; Valkenburg and Davis, 1985; Johnson and Todd, 1977). The variability and unpredictability of the arctic environment dictate that caribou have the ability to adapt their behavior (such as change the time and route of migration) to some environmental changes. Consequently, repeated exposure to human activities over their summer range has led to some degree of tolerance by caribou of the CAH. Some groups of caribou that overwinter in the vicinity of Prudhoe Bay and near Camp Lonely on the NPR-A, and that have been frequently exposed to disturbance, apparently have become somewhat accustomed to human activities. However, most caribou that overwinter to the south, in the foothills of the Brooks Range or beyond, are less tolerant of human activities, to which they are seasonally or intermittently exposed, than animals that overwinter on the coast near oilfield facilities.

Some displacement of the CAH from a portion of the calving range near the Prudhoe Bay and Milne Point facilities is well documented (Cameron, Whitten, and Smith, 1981, 1983; Cameron et al., 1992). This displacement of caribou cows and calves has occurred within about 1.86 to 2.48 mi (3 to 4 km) of oil facilities (Dau and Cameron, 1986; Nellemann and Cameron, 1996). The use of specific calving sites within the broad calving area varies from year to year, and the amount of displacement may have increased on the oilfields. In the Kuparuk-Milne Point area, the relative distribution of calving has shifted away from development facilities (Lawhead et al. 1997). Recent information on the body weight of CAH caribou calving in the oilfields compared to CAH caribou calving farther east (east of the Sagavanirktok River) suggests that displacement-disturbance of cow caribou on the oilfields may be affecting caribou productivity (Cameron, 1994). The avoidance of the Prudhoe Bay oil-field complex of roads and pipelines by cow caribou represents a functional loss of summer habitat (Cameron et al., 1995).

Recent studies (Roby, 1978; Cameron, Whitten, and Smith, 1981, 1983; Cameron et al., 1992; Pollard and Ballard, 1993) indicate significant seasonal avoidance of habitats within 1.86 to 2.48 mi (3-4 km) of existing Prudhoe Bay area facilities by cows and calves during calving and early postcalving periods (May through June). Therefore, disturbance from vehicle traffic and human presence associated with present levels of oil development in the Prudhoe Bay area has affected the distribution of CAH caribou on the calving and summer range. However, as of yet, there is no conclusive evidence that CAH caribou abundance has been affected—the CAH has greatly increased during early development of the North Slope oilfields. This increase in numbers is not to be inferred as caused by oil development. The CAH peaked at 23,000 in 1992, but declined to about 18,100 animals in 1994 with all of the decline occurring among caribou using the oilfields.

Cameron, Whitten, and Smith (1983) also reported that caribou cow/calf groups avoid the 124-mi-long (200-km) northern portion of the TAPS and Dalton Highway (Haul Road) corridor, particularly during the postcalving period. However, caribou cow/calf groups may be avoiding the TAPS corridor because it runs primarily along the riparian habitat of the Sagavanirktok River valley, a habitat type that cows and calves typically avoid during the postcalving season because of the possible presence of hidden predators such as wolves (Carruthers, Jakimchuk, and Ferguson, 1984). Carruthers, Jakimchuk, and Ferguson (1984) reported no significant differences in cow/calf distribution between the TAPS corridor and other riparian habitats on the summer range of the CAH. Also, caribou cow/calf groups did not avoid a portion of the TAPS corridor that is 2.5 mi (4 km) away from riparian habitat and the Dalton Highway (Carruthers, Jakimchuk, and Ferguson, 1984). The latter investigators concluded that the differences in the distribution of cows with calves along the TAPS corridor reported by Cameron, Whitten, and Smith (1983) reflect a seasonal preference to avoid riparian habitats, on which most of the corridor is located. However, Whitten and Cameron (1986) reported that Carruthers, Jakimchuk, and Ferguson (1984) incorrectly analyzed the data, and caribou did not avoid riparian habitats. Carruthers, Jakimchuk, and Ferguson (1984) did not investigate the question of whether cows with calves avoid the Dalton Highway during periods of high levels of truck traffic. The mere physical presence of the pipeline and associated facilities probably has no apparent effect on the behavior, movement, or distribution of caribou, except perhaps when heavy snowfall may prevent some animals from crossing under or over the pipeline. On the other hand, human activities associated with transportation routes—particularly road traffic—can affect the behavior and distribution of caribou. Frequent disturbance can have energetic effects on caribou. Pipeline-road corridors across the Arctic Slope (east-west) also could hamper the movements of the caribou herds (E. Brower, Testimony In Barrow, Alaska, on the Diapir Field Lease Offering FEIS 1983, USDOI, MMS Alaska OCS Region 1983). During the winter, drifting snow along elevated (5 ft) pipelines can block or interrupt caribou movements when snowdrifts under the pipeline (Issac Nukapigak, speaking at the NPR-A Public Scoping Meeting, Nuiqsut AK, March -April 1997). However, such an effect is expected to be temporary, with the caribou moving across the corridors when vehicle traffic has passed.

For caribou in the Prudhoe Bay and Kuparuk oil fields and pipeline-road corridors, the greatest manmade influence on behavior and movement is caused by vehicle traffic (particularly high traffic levels, such as 40-60 vehicles/hour, or traffic levels >15 vehicles/hour) in the pipeline-road corridors (Murphy and Curatolo, 1984; Lawhead and Flint, 1993). Caribou are hesitant to cross the Dalton Highway and other roads on the oilfields because of all the road traffic (Leonard Lampe, speaking at the NPR-A Public Scoping Meeting in Nuiqsut, Alaska, March-April, 1997). A decline in the frequency at which caribou cross pipeline corridors is attributed to high traffic levels on the adjacent road and the frequency of severe disturbance reactions exhibited by caribou during crossing (Curatolo, 1984). Caribou generally hesitate before crossing under an elevated pipeline (there is no problem with buried pipelines) and may be delayed in crossing a pipeline and road for several minutes or hours during periods of heavy road traffic, but successful crossings do occur. Caribou have returned to areas of previous disturbance after construction was complete in other development areas (Hill, 1984; Northcott, 1984). In the planning area, roads will be built within the oilfield but not along the pipeline to the TAPS, so disturbance of caribou would be limited.

Construction of existing pipelines and facilities on the North Slope has necessitated the use of large quantities (several million tons) of gravel. Roads and gravel pads for facilities occupy several square miles of tundra, and small areas of tundra vegetation were excavated at the gravel-quarry sites. However, these areas represent a very small percentage of the available tundra-grazing habitat. The construction of roads and gravel pads also provides the caribou with additional insect-relief habitat, particularly when little or no traffic is present. The loss of relatively small areas of tundra habitat to gravel pads, roads, and other alterations generally has not had significant effects on the CAH. However, displacement of calving caribou due to disturbance has resulted in a significant functional loss of habitat on the oilfields.

2) Effects on Moose: A number of studies show that the TAPS has no significant effect on moose movements and habitat use near the pipeline (Sopuck and Vernam, 1984; 1986; Eide, Miller, and Chihuly, 1986). In one study, 94 percent of the moose successfully crossed the pipeline corridor after entering it, and moose distribution was independent of distance from the pipeline (Sopuck and Vernam, 1986). However, moose preferred to cross pipelines elevated above 5 ft (Sopuck and Vernam, 1984). Under Alternative B, the pipeline (elevated >5 ft) connecting with the TAPS and the pipelines and roads within the oilfield itself, are not expected to affect moose habitat use and movements.

3) Effects on Grizzly Bears: Major sources of noise include seismic operations, construction of roads, installation of pipelines, gravel mining and dredging, and drilling operations. These activities may disturb grizzly bears occurring within a few miles of the noise sources. In the case of denning bears, industrial activities and human presence pose potentially serious disturbances. Experience with captive female polar bears suggests that these bears can be especially sensitive to noise and human presence during maternity denning. In one study, seismic activities within 1.15 mi (1.8 km) of a grizzly bear den caused changes in heart rate and movement of the female bear and cubs (Reynolds, Reynolds, and Follman, 1986). The latter investigators suggest that seismic-testing activities within about 600 ft of the den may cause abandonment of the den. Human scent and other noises also may disturb the bears. However, in a study of maternal denning of polar bears and their cubs, disturbances from capture, marking, and radio tracking did not affect litter sizes or the stature of cubs produced. This tolerance and the fact that maternal investment in the denning effort increases through the winter indicate that spatial and temporal restrictions on development activities could prevent abandonment of the dens (Amstrup, 1993).

Initially, when grizzly bears first encounter humans on foot, their response is to flee; responses to ground-based human activities are stronger than responses to aircraft, especially when encounters occur in open areas such as the Arctic Slope (McLellan and Shackleton, 1989). The increase in human presence and encounters with grizzly bears associated with recreation and tourism is usually temporary in nature. However, the establishment of permanent settlements (oilfields, mines, etc.) usually leads to human-bear encounters on a regular basis and to conflict, particularly when bears learn to associate humans with food (Schallenberger, 1980; Harding and Nagy, 1980; Miller and Chihuly, 1987; McLellan, 1990). Grizzly bears will initially avoid human settlements due to the noise and disturbance (Harding and Nagy, 1980), but if the area includes an important food source (such as a fish stream), some bears are likely to habituate to the noise and human presence, leading to an increase in encounters. People often will not accept the risk of bear attacks, and these encounters too often lead to the loss of bears (Archibald, Ellis, and Hamilton, 1987). However, individual bears, especially females with cubs, vary in the degree of habituation-tolerance to human presence, and some will continue to avoid areas when humans are present (Olson and Gilbert, 1994).

The attraction of grizzly bears to garbage-food odors at field camps and other facilities has lead to encounters in which the need to protect workers results in the loss of bears (Schallenberger, 1980). Once bears become conditioned to the availability of human sources of food, measures to reduce this availability by improved garbage handling are not always effective (McCarthy and Seavoy, 1994). The bears will make an extra effort to get to the food sources that they are conditioned to having.

In Alaska, nonsport (or nonsubsistence) mortality of grizzly bears has increased from 1970 to 1985 and is expected to increase further with development (logging, mining, etc.) and establishment of settlements in remote areas (Miller and Chihuly, 1987). The losses of brown as well as black bears from incidental shootings by people in defense of life and or property generally has not been significant to the bear populations as a whole, but such losses contribute to a cumulative decline in bears and in their distribution near cities and villages in Alaska. As human populations in Alaska increase, the numbers of brown bears are expected to decrease particularly outside of national parks, refuges, and wilderness areas.

Oil exploration and development under Alternative B is expected to attract some grizzly bears to oilfield facilities and may result in the loss of some bears due to interactions with humans.

4) Effects on Wolves: Potential effects on wolves include disturbance from air and surface traffic and human presence, and increased hunting pressure through improved access that may be associated with oil development. If caribou abundance were affected by oil development, wolf abundance could be adversely affected in return.

5) Effects on Wolverines: Potential effects on wolverines could include disturbance from air and surface-vehicle traffic, increased human presence, and habitat alteration. Because wolverines are considered a shy and secretive species, they may be sensitive to oil exploration and development activities and abandon habitat areas near oil development. Winter seismic activities in the Pik Dunes area south of Teshekpuk Lake caused the displacement of a wolverine from its den (Harry Brower, Jr., Research Specialist, NSB Wildlife Department, speaking at the NPR-A Scoping Meeting, March-April 1997). If caribou abundance were adversely affected by oil development, wolverines could be affected in return. Decline in distribution and abundance of wolverines in Canada was attributed to increased harvest and decline in caribou populations (Van Zyll de Jong, 1975). Alteration of riparian habitats through gravel excavation could adversely affect wolverines, especially during the winter, when theses habitats provide cover and important hunting areas for wolverine. Because the wolverine is an important subsistence species, any decline in their abundance within the NPR-A proposed lease area would adversely affect subsistence. Some wolverines may be displaced near (within a few miles) of oil-field facilities under Alternative B.

6) Effects on Muskoxen:

Exploration: Studies on the effects of oil and gas exploration on muskoxen in Alaska and Canada have focused on disturbances associated with winter seismic operations. Some muskoxen reacted to seismic activities at distances up to 2.48 mi (4 km) from the operations; however, reactions by muskoxen were highly variable among individuals, with some individuals not reacting at very close distances (0.12 mi [0.2 km] ((McCarthy and Seavoy, 1994). Responses varied from no response to becoming alert, forming defense formations, or running away (Winters and Shideler, 1990). The movements of muskoxen away from the seismic operations did not exceed 3.1 mi (5 km) and had no apparent effect on muskoxen distribution (Reynolds and LaPlant, 1986). Helicopter support traffic seemed to have an cumulative effect on muskoxen responses to seismic activities (Jingfors and

Lassen, 1994). Muskoxen reacted to helicopters flown at 325 and 1,300 ft (100 and 400 m) with durations of responses lasting from 2 to 12 minutes (Miller and Gunn, 1984). Muskoxen cows and calves appear to be more sensitive (responsive) to helicopter traffic than other age/sex classes, and muskoxen in general are more sensitive to overflights by helicopter than by fixed-wing aircraft (Miller and Gunn, 1979; Reynolds, 1986). Disturbances during the calving season may result in abandonment of the calf, if it occurs within the first or second day of life (Lent, 1970). Muskoxen appear to habituate to helicopter flights above about 500 ft (180 m), at least on a short-term basis (Miller and Gunn, 1980). Groups of muskoxen appear to be less responsive to fixed-wing aircraft overflights during the summer, rut, and fall than during winter and calving periods (Reynolds, 1996).

In general, muskoxen responses to seismic activities in the planning area are expected to be a gradual and temporary avoidance of the local area, with reoccupation of the area after the exploration activities are complete (Urquhart, 1973; Jingfors and Lassen, 1984).

Development: Potential effects of oil-development activities include direct habitat loss from gravel mining in river floodplains and at oilfield facilities, and indirect habitat loss through reduced access caused by physical or behavioral barriers created by roads, pipelines, and other facilities (Clough et al., 1987, as cited by Winters and Shideler, 1990; Garner and Reynolds, 1986). Muskoxen may be more vulnerable to oil exploration than caribou, because they tend to remain year-round in the same habitat area (Jingfors, 1982); however, muskoxen may be more likely to habituate due to year-round exposure. Muskoxen have been exposed to the TAPS and the Dalton Highway with the expansion of their range west from ANWR and the Kavik River.

7) Effects on the Arctic Fox: Oil and gas exploration and development activities can affect the arctic fox by increasing the availability of food and shelter. Seismic camps and oilfield facilities provide additional food sources for foxes at dumpster sites near the galley and dining halls and at dump sites (Eberhardt et al., 1982; Rodrigues, Pollard, and Skoog, 1994). Crawlspaces under housing, culverts, and pipes provide foxes with shelter for resting and, in some cases, artificial dens (Eberhardt et al., 1982; Burgess and Banyas, 1993). At least localized seismic and oil development activities do not appear to have any dramatic, deleterious effect on the fox population (Eberhardt et al., 1982). A study of den sites and fox productivity in the area of Prudhoe Bay indicates that adult fox densities and pup production are higher in the oilfields than in surrounding undeveloped areas (Burgess et al., 1993). An increase in the fox population associated with oil development may adversely affect some fox-prey species (such as ground-nesting birds) in the development area and over a region larger than the oilfield itself (Burgess et al., 1992).

8) Effects on Other Small Mammals: Small rodents (such as lemmings and voles) and their predators (such as short-tailed weasels) are expected to be affected locally (direct mortality and loss of habitat of individuals or small groups of lemmings and voles) along seismic lines, pipelines, gravel pads, and other facilities. However, these losses are expected to be insignificant to populations on the Arctic Slope of Alaska.

(c) Effects of Spills:

1) Spill Effects on Caribou, Moose, Muskoxen: Caribou and other terrestrial mammals may become oiled or may ingest contaminated vegetation. Caribou, moose, and muskoxen that become oiled are not likely to suffer from a loss of thermoinsulation during the summer, although toxic hydrocarbons could be absorbed through the skin or inhaled. However, the oiling of young calves could significantly reduce thermoinsulation, leading to their death. Oiled caribou, moose, and muskoxen hair would be shed during the summer before the winter fur is grown. Toxicity studies of crude-oil ingestion in cattle (Rowe, Dollahite, and Camp, 1973) indicate that anorexia (significant weight loss) and aspiration pneumonia leading to death are possible adverse effects. Caribou, moose, and muskoxen that become oiled by contact with a spill in contaminated lakes, ponds, rivers, or coastal waters could die from toxic-hydrocarbon inhalation and absorption through the skin.

Under Alternative B, an estimate of 0 to 17 (>1 bbl) crude-oil spills (averaging 4 bbl in size) and 0 to 162 small refined oil-spills (averaging 29 gal in size) are assumed to occur onshore over the production life of the planning area (Tables IV.A.2-2 and 2-6). These small, chronic spills are expected to result in the loss of small numbers of caribou and other terrestrial mammals but to have an additive effect, perhaps increasing contamination of terrestrial habitats along pipeline corridors.

If a pipeline spill occurred, some tundra vegetation within the pipeline corridor would become contaminated. However, caribou (also moose and muskoxen) probably would not ingest oiled vegetation, because they tend to be selective grazers and are particular about the plants they consume (Kuropat and Bryant, 1980). It also is likely that control and cleanup operations (ground traffic, air traffic, and personnel) at the spill site would frighten caribou, moose, and muskoxen away from the spill and prevent the possibility of these animals grazing on the oiled vegetation. Thus, onshore oil spills associated with Alternative B are not expected to significantly affect caribou, moose, and muskoxen through ingestion of oiled vegetation.

Oil spills on wet tundra kill the moss layers and aboveground parts of vascular plants and sometimes kill all macroflora at the site (McKendrick and Mitchell, 1978). Damage to oil-sensitive mosses may persist for several years, if the site is not rehabilitated (e.g., by applying phosphorus fertilizers) (McKendrick and Mitchell, 1978). For the most part, onshore oil spills would be very local (1-2 acres) in their effects and would not be expected to significantly contaminate or alter caribou, moose, and muskoxen range. However, some local contamination of tundra vegetation is expected to occur near production wells and processing facilities. Spills that occur within or near streams and lakes may affect foraging habitat over larger areas.

2) Spill Effects on Grizzly Bears: Grizzly bears depend on coastal streams, beaches, mudflats, and river mouths during the summer and fall for catching fish and finding carrion. If an oil spill contaminates beaches and tidal flats along the Beaufort Sea coast, some grizzly bears are likely to ingest contaminated food, such as oiled birds, seals, or other carrion. Such ingestion could result in the loss of at least a few to several bears. An oiling experiment on captive polar bears indicated that if a bear's fur becomes oiled and the bear ingests a considerable amount of oil while grooming, kidney failure and other complications could lead to the bear's death (Oritsland et al., 1981). Brown bears on the Shelikof Strait coast of Katmai National Park (an area contacted by the *Exxon Valdez* oil spill) were observed with oil on their fur and were consuming oiled carcasses (Lewis and Sellers, 1991). A study of the exposure of Katmai National Park (Katmai Bay area) brown bears to the *Exxon Valdez* oil spill through analysis of fecal samples indicated that some bears had consumed oil or were exposed to oil; one young bear that died had high concentrations of aromatic hydrocarbons in its bile and might have died from oil ingestion (Lewis and Sellers, 1991). Anecdotal accounts of polar bears deliberately ingesting hydraulic oil and motor oil as well as foreign objects from human garbage sites suggest that both bear species are vulnerable to ingesting oil directly, especially from oiled carrion and other contaminated food sources (Derocher and Stirling, 1991). Skin damage and temporary loss of hair can result from oiling of bears with adverse effects on thermal insulation (Derocher and Stirling, 1991). The small spills assumed to occur under Alternative B could result in the loss of small numbers of grizzly bears through ingestion of contaminated prey or carrion. However, such losses are not expected to be significant to the population on the Arctic Slope.

Summary: Alternative B is expected to increase the level of noise and disturbance and habitat alteration effects on terrestrial mammals in the southern half of the planning area over the level of effect under Alternative A. The primary sources of disturbance to caribou, muskoxen, moose, and other terrestrial mammals associated with oil exploration are activities associated with seismic operations. The primary source of disturbance associated with oil development is road traffic within the oilfield; other sources of disturbance are expected to include air traffic (helicopter and fixed-wing) to and from the oilfield and humans on foot.

Under Alternative B, one oilfield is assumed to be discovered and developed in the southern half of the planning area, generally south and west of Nuiqsut. The TLH calving range lies north of the area available to leasing, so that Alternative B is expected to have little effect on caribou movements within the calving range, and no calving is expected to be displaced. Some TLH and CAH migration movements and the winter range of some caribou may be adversely affected by air and surface-vehicle traffic along pipelines and roads. However, caribou movements to coastal insect relief areas north of Teshekpuk Lake are not expected to be affected.

The pipelines and roads within the oilfield and the pipeline to TAPS are not expected to affect moose and muskoxen habitat use and movements, although individual animals may be briefly disturbed by air and surface traffic. Some grizzly bears are expected to be attracted to oilfield facilities and some may be lost due to interactions with humans. Some wolverines may be displaced within a few miles of oilfield facilities. In general, muskoxen responses to mobile seismic operations are expected to be a gradual and temporary avoidance of the local area with reoccupation of the area after the exploration activities are complete. During development and production, avoidance may persist over the life of the oilfield. Arctic fox abundance is expected to increase near the oilfield due to increased food sources and shelter.

Assuming the occurrence of small crude-oil and fuel spills (averaging 4 bbl and 29 gal, respectively), caribou of the TLH and CAH, moose, muskoxen, grizzly bears, and other terrestrial mammals could be directly exposed to and contaminated by the spill at river crossings, contaminated ponds or lakes, along the beaches, and in shallow waters during periods of insect-pest-escape activities. Grazing animals could be exposed through ingestion of or contact with oiled vegetation. However, even in a severe situation, a comparatively small number of animals are likely to be directly exposed to the oil spills and die as a result of toxic-hydrocarbon inhalation and absorption, and/or loss of thermoinsulation. These losses probably would be small for any of these terrestrial mammal populations and are expected to be replaced within less than one generation (about 1 year). For the most part, the effect of pipeline spills would be very local and would contaminate tundra in the immediate vicinity of the pipeline; these spills would not be expected to significantly contaminate or alter terrestrial mammal ranges within the pipeline corridors.

Conclusion—First Sale: For activities other than oil and gas, air traffic, humans on foot, and the presence of resource-inventory-survey camps are expected to increase under Alternative B as compared to Alternative A, but these activities are not expected to affect terrestrial mammal populations. For oil and gas activities, the level of effects due to noise, disturbance, and habitat alteration is expected to increase in the southern half of the planning area. Increased habitat alteration would include the development of one oilfield and a pipeline to the TAPS. Caribou of the CAH and TLH are expected to be disturbed and their movements delayed along the pipeline during periods of air overflights (for example, to inspect the pipeline), but these disturbances are not expected to affect migrations and overall distribution. Near oilfield facilities, surface, air, and foot traffic are expected increase under Alternative B and to displace some caribou, moose, muskoxen, grizzly bears, wolfs, and wolverines but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year.

Multiple Sales: If several lease sales occur under Alternative B, considerably more exploration activity is expected to occur in the southern half of the planning area, with the number of exploration wells drilled increasing from 1 to 4 under the first sale to 4 to 14 under multiple sales. The amount of development also is expected to increase, with the number of oilfields increasing from 0 to 1 under the first sale to 0 to 2 under multiple sales, the number of production pads increasing from 0 to 2 under the first sale to 0 to 4 under multiple sales, and pipeline miles pipeline increasing from 0 to 75 under the first sale to 0 to 90 under multiple sales. The level of effects on caribou and other terrestrial mammals, including noise, disturbance, and habitat alteration, is expected to increase in the southern half of the planning area with multiple sales under Alternative B. Caribou of the CAH and TLH are expected to be disturbed and their movements delayed along the pipeline during periods of air overflights (for example, to inspect the pipeline), but these disturbances are not expected to affect migrations and overall distribution. Near oilfield facilities, surface, air, and foot traffic are expected increase somewhat under multiple sales and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations.

With multiple sales under Alternative B, the number of small crude-oil spills (>1 bbl) is expected to increase from an estimated 0 to 17 crude-oil spills under the first sale to 0 to 25 under multiple sales (average size of 4 bbl) and increase from a total of 0 to 162 small fuel-oil spills under the first sale (average size of 29 gal) to 0 to 232 under multiple sales are estimated to occur onshore over the production life of the planning area (Tables IV.A.2-3a, IV.A2-3b, IV.A.2-6a and IV.A.2-6b). These small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B with the first sale but with loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations.

Conclusion—Multiple Sales: The level of effects due to noise, disturbance, and habitat alteration is expected to increase in the southern half of the planning area under Alternative B with multiple sales. Near oilfield facilities, surface, air, and foot traffic are expected increase and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines, but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year.

Effectiveness of Stipulations: Stipulations described in Section II.C.7 regarding solid- and liquid-waste disposal, fuel handling, and spill cleanup are expected to reduce the potential effects of spills and human refuse on grizzly bears and other terrestrial mammals. Stipulations on overland moves and seismic work are expected to minimize alteration of terrestrial mammal habitats in the planning area. The stipulation on aircraft to maintain 1,000 ft AGL (except for takeoffs and landings) over caribou winter ranges from October through May 15, and 2,000 ft AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, is expected to minimize disturbance of caribou. Stipulations on oil and gas exploration and development including facility design and construction of pipelines, roads, drill pads, airstrips, and other facilities are expected to minimize interference with caribou movements and minimize the amount of terrestrial mammal habitat altered by gravel pads and other surface disturbances. The designation of the Colville River as a wild river under the Wild and Scenic River System could reduce potential noise and disturbance of TLH, CAH, and WAH caribou movements across the river from motorized boats and other human activities through restrictions in motorized travel and development activities (such as roads) within ½ mi on the west side of the river within the southern boundary of the NPR-A to the Umiat Meridian.

b. Marine Mammals: Six species of nonendangered marine mammals—ringed, spotted, and bearded seals, walruses, polar bears, and belukha whales—commonly occur year-round or seasonally in coastal habitats adjacent to the planning area. Under Alternative B, some individual members of these species may be exposed to effects from oil and gas activities in the Colville River Delta-inner Harrison Bay area and to effects from other activities. For the purpose of this analysis, generation is defined as the average time interval between the birth of the female parent and the birth of their offspring. The generation time for ringed seals is about 4 to 8 years and about 7 years for polar bears (Kelly, 1988; USDOI, FWS, 1995).

(1) Activities Other than Oil and Gas Exploration and Development: Activities other than oil and gas exploration and development along the coast that may affect marine mammals include aerial surveys (including surveys of wildlife); ground activities such as resource inventories, paleontological excavations, research and recreation camps; and overland moves. Effects under Alternative B would be similar to those for Alternative A—local and short term, with no significant adverse effects to the populations as a whole.

(2) Oil and Gas Exploration and Development Activities: Oil and gas exploration and development activities along the coast that may affect marine mammals are noise and disturbance from air and surface traffic, geophysical seismic activities. Small onshore crude- and fuel-oil spills associated with Alternative B are not expected to reach the marine environment and affect marine mammals.

(a) Effects of Noise and Disturbance: Noise associated with oil and gas activities is a primary source of disturbance of seals, polar bears, and belukha whales. For a discussion of the nature of airborne and underwater noise effects on pinnipeds, polar bears, and belukha whales, see the Sale 124 FEIS (USDOI, MMS, 1990). A discussion of noise and disturbance effects specific to the planning area follows.

The primary source of noise and disturbance would come from air traffic along the coast of the planning area, specifically from helicopters associated with the assumed oil exploration and production activities. Aircraft traffic (several helicopter round trips/day during exploration and development) centered out of Deadhorse-Prudhoe Bay, traveling to and from NPR-A exploration and production facilities, is assumed to be a potential source of disturbance to ringed or spotted seals hauled out on the ice or beaches, respectively, along the coast and polar bears using coastal habitats.

During the summer, some of the air traffic to and from exploration and production facilities could disturb ringed, bearded, and spotted seals hauled out on the ice along the coast, causing them to charge in panic into the water. Because of frequent low visibility due to fog, aircraft may not always be able to avoid disturbing hauled-out seals. The number of seals affected would depend on the number of disturbance incidents. Aircraft disturbance of hauled-out seals in the planning area could result in injury or death to young ringed and bearded seal pups. Although air-traffic disturbance would be very brief, the effect on individual seal pups could be severe. Aircraft disturbance of small groups of spotted and ringed seals hauled out along the coast is not likely to result in the death or injury of large numbers of seals, although increases in physiological stress caused by the disturbance might reduce the longevity of some seals, if disturbances were frequent.

If exploratory drilling occurs during the winter (December to mid-April) near the coast, polar bears could be attracted to the oilfield camps by food odors and curiosity. Some polar bears could be unavoidably killed to protect oil workers. Under the Marine Mammal Protection Act, the oil companies would be required to have a permit to take or harass polar bears. Consultation between the companies and the FWS on this matter is expected to result in the use of nonlethal means of protection in most cases. In any event, the number of bears lost as a result of such encounters is expected to be very low.

(b) Effects of Seismic Activities: Effects will be similar to those under Alternative A, i.e., short-term effects on a small number of polar bears that den along the coast of the planning area could occur.

Conclusion—First Sale: For marine mammals, the effects of activities other than oil and gas under Alternative B are expected to be similar to those under Alternative A—local and short term, with no significant adverse effects to the populations as a whole. The effects of oil and gas activities for Alternative B are expected to increase somewhat over those of Alternative A. However, most oil and gas activities under Alternative B are expected to occur inshore and far to the south of the coast. Only a small increase in potential noise and disturbance effects is expected along the coast, primarily in the Colville River Delta-inner Harrison Bay area, and these effects are expected to be local and short term (generally <1 year).

Multiple Sales: If several lease sales occur under Alternative B, considerably more exploration activity is expected to occur in the southern half of the planning area with the number of exploration wells drilled increasing from 1 to 4 under the first sale to 4 to 14 under multiple sales. The amount of development also is expected to increase, with the number of oilfields increasing from zero to one under the first sale to zero to two under multiple sales; the number of production pads increasing from zero to two under the first sale to zero to four under multiple sales; and pipeline miles increasing from 0 to 75 under the first sale to 0 to 90 under multiple sales. However, most oil and gas activities under Alternative B are expected to occur inshore and far to the south of the coast. Only a small increase in potential noise and disturbance effects on marine mammals is expected along the coast, primarily in the Colville River Delta-inner Harrison Bay area, and these effects are expected to be local and short term (generally <1 year).

Conclusion—Multiple Sales: Multiple sales under Alternative B are expected to have similar effects to those under Alternative B with one sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Effectiveness of Stipulations: The effectiveness of stipulations is expected to be the same as under Alternative A.

10. Endangered and Threatened Species:

a. Activities Other Than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may affect bowhead whales and spectacled and Steller's eiders under Alternative B include aerial surveys (including that of wildlife) and ground activities, such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall. Overland moves and seismic surveys, which occur during the winter on ice roads or frozen tundra, are discussed but are unlikely to have an effect on these species. A description of these activities and potential effects on these species are discussed in Alternative A and summarized here. The potential effects from these activities are expected to be the same as described for Alternative A. A detailed discussion of all management actions is found in Section II.

Bowhead whales are not likely to be affected by any activities associated with the management plan. Some eiders may be affected by activities associated with aircraft traffic and hazardous- and solid-material removal and remediation. These activities may continue for as long as 3 to 4 weeks. Summertime aircraft flights over these sensitive areas may affect nesting females and their broods. Under Alternative B, point-to-point flights increase from occasionally to regular but not daily, aerial wildlife surveys increase from 14 days to 21 days during June and July, and other aerial surveys increase from occasionally to several 1- to 2-week periods (Table II.D.3). Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake (Spectacled Eider LUEA) may be overflown by aircraft (both helicopters and fixed-wing) on a regular basis during the summer months and may experience temporary, nonlethal effects probably lasting less than an hour. Due to the relatively low density of eiders in the area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

b. Oil and Gas Exploration and Development Activities: Under Alternative B oil and gas leasing would occur in the planning area, although the northern portion of the planning area extending well south of Teshekpuk Lake is unavailable for oil and gas leasing. No leasing would occur in the Spectacled Eider LUEA. In addition, leasing would not occur in any of the higher density spectacled eider nesting areas outside of the spectacled eider LUEA. This analysis is based on a development scenario presented in Section IV.A.1.b. The reader is referred to these sections for a discussion of resource-recovery rates and quantities, timing of infrastructure development, platform emplacement, wells drilled, and resource production timeframes and other information relevant to the development of the resources of the IAP. The scenarios for oil and gas exploration and development activities range from exploration only for the low end of the resource range under Alternative B to development/production with oil resources in the 250- to 1,100-MMbbl range with from 1 to 5 fields under Alternative E, which is considered a reasonable range of resource development and activity level for the planning area. The BLM also proposes to conduct multiple oil and gas lease sales within the planning area over a number of years, which is likely to result in a larger resource range. Multiple sales are discussed later in this section.

Three types of crude-oil spills are associated with exploration, development, and production of oilfields in the planning area, including accidental crude-oil spills from platforms, pipelines, and flowlines; blowouts of crude oil; and TAPS spills. Approximately 65 to 80 percent of all crude-oil spills are expected to occur on the drilling pad and would have little or no effect on the environment. Approximately 20 to 35 percent may occur on or reach the surrounding environment (Sec. IV.A.2). Those spills that reach the surrounding environment generally cover a small area (<500 ft²). ARCO Alaska Inc. reports the largest tundra area impacted from a spill is approximately 1.5 acres. Accidental spills on the drilling pads and from pipelines are expected to be small. From 1989 to 1996, 56 percent of all crude spills on the Alaskan North Slope were <5 gal, and 99 percent were <25 bbl. For the purposes of analysis, this EIS assumes an average spill size of 4.0 bbl (see Table IV.A.2-2a). The potential for a blowout during drilling operations is considered negligible. Additional information pertaining to oil spills in the planning area can be found in Section IV.A.2.

It is assumed that crude oil would not be released during exploration. Activities that would occur during development and production are similar to those that would occur during exploration, with the addition of activity associated with oil transport. A spill of crude oil during development or production could affect individual species, as discussed below. In addition, cleanup activities associated with any oil spill may result in disturbance.

Under Alternative B, oil resources for the initial sale are expected to be in the 65- to 350-MMbbl range with from 0 to 1 fields, which is considered a reasonable range of resource-development and activity level for the portion of the planning area open to leasing (Table IV.A.1.b-5). Information on the number of exploration, delineation, and production wells anticipated to be drilled and pipeline miles can be found in Table IV.A.1.b-5. Resources at the low end of the resource range (65 MMbbl) are not economically viable as stand-alone fields. Differences in effects on the species as a result of noise and disturbance over this range of scenarios are expected to be minor. Differences in effects on the species as a result of an oil spill during the development/production scenario (65-350-MMbbl-resource range) also are expected to be minor.

For Alternative B, it is estimated that from 0 to 53 spills <1 bbl would occur and from 0 to 17 spills >1 bbl would occur over the assumed production life of the planning area (Table IV.A.2-3a). For the purposes of analysis, this EIS assumes an average spill size of 4.0 bbl and that the estimated number of crude oil spills over the assumed production life of the planning area would range from 0 to 70 spills (Table IV.A.2-2a). Information pertaining to oil spills can be found in Section IV.A.2.

(1) Effects on the Bowhead Whale: Bowhead whales may be present in the area offshore of the planning area primarily from August through October during their fall migration back to the Bering Sea. Bowhead whales are not likely to be affected by activities associated with the management plan other than oil and gas exploration and development. The following discussion describes how bowhead whales may be affected by oil and gas activities.

(a) Effects of Discharges: All drilling muds and cuttings will be hauled to approved disposal sites or disposed of in existing wells, so there will be no surface discharge of drilling wastes. No drilling activities will occur in the marine environment under this IAP, so no drilling muds and cuttings will be discharged into the marine environment. There should be no effects on bowhead whales as a result of discharges.

(b) Effects of Noise and Disturbance: Concern has been expressed that manmade noise may affect bowheads by raising background-noise levels—which could interfere with detection of sounds from other bowheads or from important natural sources—or by causing disturbance reactions. Noise-producing activities, including aircraft traffic and marine-vessel traffic, are the activities most likely to affect bowhead whales. Seismic surveys, drilling, construction activities, and oil-spill-cleanup activities also are discussed but are not likely to affect bowhead whales. A detailed description of these activities and their potential effects on bowhead whales in the MMS Beaufort Sea OCS Planning Area can be found in Section IV.B.a.1 of the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a). Activities associated with the proposed oil and gas sale in the planning area under this alternative and their potential effects on bowhead whales follows.

1) Effects from Seismic Activities: No marine seismic surveys will occur as a result of this IAP. It is likely that seismic surveys in the planning area will be conducted entirely during the winter months (early December to mid-April) using all-terrain ground vehicles and supported by light aircraft. There should be no effects on bowhead whales as a result of seismic surveys.

2) Effects from Aircraft Activities: Aircraft likely will be used to support oil and gas exploration activities in the planning area. Seismic surveys and drilling operations probably would be conducted during the winter months, so aircraft support of these activities also would occur primarily during the winter. Any aircraft flights over the marine environment during the open-water season as a result of oil and gas operations in the planning area are likely to be minimal, if any even occur. Bowheads are not affected much by any aircraft overflights at altitudes above 328 yards (Richardson and Malme, 1993). In addition, any such flights likely would be very near shore, well away from the normal migration corridor. It is unlikely there will be any effects on bowhead whales as a result of aircraft flights.

3) Effects from Vessel Activities: There may be some transportation of equipment and supplies through the marine environment during the open-water season. Due to logistics problems associated with moving materials over the long distances from existing infrastructure, barges may be used to transport heavy equipment and supplies. Staging areas may be established along the coastline of the planning area and materials transported and stockpiled during the summer months (mid-July to early October) for operations at inland sites during the winter months.

Bowheads react to the approach of vessels at greater distances than they react to most other industrial activities. Most bowheads begin to swim rapidly away when vessels approach rapidly and directly. Avoidance usually begins when a rapidly approaching vessel is 0.62 to 2.5 mi away. A few whales may react at distances from 3 to 8 mi, and a few whales may not react until the vessel is <0.62 mi away. Received noise levels as low as 84 dB re 1 µPa or 6 dB above ambient noise may elicit strong avoidance of an approaching vessel at a distance of 2.5 mi (Richardson and Malme, 1993, as cited in USDOI, MMS, 1996a). Bowhead whales may encounter a few vessels associated with oil and gas activities in the planning area during their fall migration through the Alaskan Beaufort Sea, although most of the vessel activity would be in shallow, nearshore waters, probably shoreward of the main fall whale-migration route. Vessel traffic generally would be limited to routes between staging areas near existing infrastructure (such as West Dock or Oliktok Point) and staging areas in the planning area, such as Camp Lonely or Umiat.

In general, bowheads may exhibit avoidance behavior if approached by vessels at a distance of 0.62 to 2.5 mi. Fleeing from a vessel generally stopped within minutes after the vessel passed, but scattering may persist for a longer period. In some instances, bowheads returned to their original locations. Any effects on bowhead whales as a result of barge or other vessel traffic are likely to be minimal.

4) Effects from Drilling Activities: Exploration-drilling activities will be conducted only onshore and only during the winter months; bowhead whales would not be affected by the activity. If a commercial discovery is made, drilling of production wells likely will proceed during the summer months. Table IV.A.1.b-5 provides information regarding the number of wells likely to be drilled and the timeframe for drilling, development, and production for the estimated range of resources (65-350 MMbbl) in the planning area. Because no leasing will occur in the northern portion of the planning area under this alternative, no drilling operations will be conducted in that area. There should be no effects on bowhead whales as a result of drilling operations.

5) Effects from Construction Activities: Onshore pipeline construction or other construction activities would occur during the winter. No pipeline construction or other construction activities are expected in the marine environment. There should be no effects on bowhead whales as a result of construction activities.

6) Effects from Spill Cleanup: No spills are expected to occur in the marine environment. In the event of an oil spill in the planning area, it is likely that the spill will be contained onshore. It is unlikely that any oil spilled onshore will be released into the marine environment. If oil is spilled, personnel, equipment, and aircraft will be present conducting onshore-cleanup operations. No oil-spill-cleanup activities would occur adjacent to the coast during the bowhead whale migration, because no leasing will occur in the northern portion of the planning area under this alternative. There should be no effects on bowhead whales as a result of oil-spill-cleanup activities.

(c) Effects of Spills: The effects of an oil spill on bowhead whales are unknown. Several researchers (Geraci and St. Aubin, 1982; St. Aubin, Stinson, and Geraci, 1984, as cited in USDOI, MMS, 1996a) concluded that exposure to spilled oil is unlikely to have serious direct effects on baleen whales.

Under this alternative, there would be no leasing in the northern portion of the planning area. No spills are expected to occur in the marine environment, and small onshore spills are unlikely to reach the marine environment. If any spilled oil did reach the marine environment, it is likely to be a very small amount and is very unlikely to have any effect on bowhead whales. Because no leasing will occur in the northern portion of the planning area, the likelihood of an oil spill reaching the marine environment is small, the likelihood of exposure of bowhead whales to spilled oil is small, and any exposure to spilled oil that may occur is unlikely to have serious direct effects on bowheads, there will be no discussion of potential effects on bowheads as a result of oil spills in the planning area.

Summary: Bowhead whales are not expected to be affected by discharges, seismic surveys, drilling operations, construction activities, oil-spill-cleanup activities, or oil spills as a result of this alternative. There is a limited potential for whales to be affected by aircraft flights, although few flights, if any, are anticipated over the marine environment. Bowheads are not affected much by any aircraft overflights at altitudes above 328 yards (Richardson and Malme, 1993). Vessel traffic, such as barges transporting equipment and supplies, has the greatest potential to affect whales. Some endangered whales may interact with marine vessel traffic, and some inadvertent conflicts or incidental "taking" situations may occur. These inadvertent conflicts with or incidental "taking" situations of some individual whales as a result of marine-vessel traffic would not constitute a threat of harm to the species. Bowheads may exhibit avoidance behavior if approached by vessels at a distance of 0.62 to 2.5 mi (Richardson and Malme, 1993). In general, bowheads do not seem to travel more than a few kilometers in response to a single disturbance incident; and behavioral changes are temporary, lasting only a few minutes in the case of vessels and aircraft. It also should be noted that individuals engaged in feeding, socializing, breeding, etc., may react to a stimulus at a higher threshold than resting or milling animals.

(2) Effects on the Spectacled and Steller's Eiders: Spectacled eiders are widely distributed throughout the coastal plain portion of the planning area and are essentially absent from the area from late October to May. Most nesting on the Arctic Slope occurs along this coastline, particularly west from the Sagavanirktok River. The highest densities of nesting spectacled eiders in the planning area occur in the Spectacled Eider LUEA to the north, west, and east of Teshekpuk Lake (Fig. II.B.3). Postbreeding male spectacled eiders leave the planning area by late June. Females are present in the breeding area from May to September. Females with young typically are found offshore later, when the ice usually is farther from the coast (Peterson, 1997, pers. comm., as cited in USDOI, MMS, 1997). Steller's eiders are relatively sparsely distributed throughout the central portion of the planning area with some also present in the northern portion of the planning area. Males depart the nesting areas in late June. Females with broods are present in the breeding area from early June to late August or early September. Deferral of the northern portion of the planning area from leasing will protect almost all known spectacled eider breeding and nesting areas in the planning area from noise and disturbance associated with oil and gas activities. It isn't known for sure if Steller's eiders actually breed in the planning area.

The reaction of eiders to disturbance in the oilfields is not well understood. Anderson et al. (1992) reported a shift in distribution between 1989 and 1991 away from noisy facilities installed as part of the GHX-1 project. Anderson and Cooper (1994) reported that the mean distance from facilities to spectacled eider nests was greater than the mean distance of facilities to eider observations (mainly during the prenesting season), suggesting that eiders may be less tolerant of facilities during the nesting season. Telemetry studies in the Prudhoe Bay area provided information on responses to oilfield facilities during the broodrearing period (TERA, 1995, 1996). In 1994, two of nine tracked broods crossed roads compared with three out of five in 1993. Some broods were located in areas away from facilities. In 1994, six out of nine broods spent at least some time within 200 m of facilities. Four broods frequented areas of exceptionally high-noise facilities, consisting of two broods near the airport and two broods near gathering centers.

Spectacled and Steller's eiders may be adversely affected by activities associated with the management plan other than oil and gas exploration and development in the planning area. These potential effects are summarized above and discussed in detail in Section IV.B.10 (Alternative A).

(a) Effects of Discharges: All drilling muds and cuttings will be hauled to approved disposal sites or disposed of in existing wells, so there will be no surface discharge of drilling wastes. No drilling activities will occur in the marine environment under this IAP so no drilling muds and cuttings will be discharged into the marine environment. There should be no effects on spectacled and Steller's eiders as a result of discharges.

(b) Effects of Noise and Disturbance: Manmade noise and activities, as well as human presence, may result in disturbance of spectacled eiders in the planning area. Noise-producing activities, including aircraft traffic and marine-vessel traffic, are the activities most likely to affect spectacled eiders. Seismic surveys, drilling, construction activities including vehicle traffic, and oil-spill-cleanup activities also are discussed but are not likely to affect spectacled eiders. Noise-producing activities, including aircraft traffic, marine vessel traffic, drilling; construction activities, including vehicle traffic; and oil-spill-cleanup activities are the activities most likely to affect Steller's eiders. Activities associated with the oil and gas exploration and development in the planning area under this alternative and a discussion of their potential effects on spectacled and Steller's eiders follows.

1) Effects from Seismic Activities: No marine-seismic exploration will occur as a result of this IAP. It is likely that seismic surveys in the planning area will be conducted entirely during the winter months (early December to mid-April) using all-terrain ground vehicles and supported by light aircraft. Some 1-D and 2-D seismic operations will occur each winter, and up to two 3-D operations will occur in alternate years. There should be no effects on spectacled or Steller's eiders as a result of seismic surveys.

2) Effects from Aircraft Activities: Aircraft likely will be used to support oil and gas exploration activities in the planning area. Mostly fixed-wing aircraft would be used for oil and gas exploration and development operations, with helicopters used only in emergencies. Seismic surveys and drilling operations probably will be conducted primarily during the winter months, so aircraft support of these activities also would occur during the winter. Any aircraft flights over the marine environment during the open-water season as a result of oil and gas operations in the planning area are likely to be minimal, if any occur. Because no leasing will occur in the northern portion of the planning area under this alternative, there should be no aircraft flights associated with oil- and gas-related operations. Also, it is unlikely that the primary Alaskan nesting area for Steller's eiders, located south and southeast of Barrow, would be overflown by aircraft associated with oil and gas activities, so significant disturbance of nesting or broodrearing Steller's eiders is not expected to occur.

In the event of a commercial discovery, drilling operations and other activities may continue through the summer months and would be supported by aircraft. Pipelines are likely to be constructed above ground, and aircraft likely will be used to look for leaks in the pipeline. Balogh (1997) indicated that fixed-wing aircraft flown at an altitude of 150 ft often cause spectacled eiders to flush, although helicopters flown at similar altitudes around Prudhoe Bay do not cause them to flush. As stated previously, reactions of eiders to aircraft are not well understood. There are indications that some individuals are tolerant of aircraft activities in the vicinity of nests. Because most of the breeding, nesting, and rearing areas for spectacled eiders occur in the area closed to leasing, displacement of nesting eiders in the vicinity of pipeline corridors and near airstrips as a result of aircraft overflights is unlikely. Very few nest sites are expected to be affected because nest sites, if they occur in the area open for leasing, occur at very low density. Some displacement of nesting Steller's eiders in the vicinity of pipeline corridors and near airstrips in the central portion of the planning area could occur as a result of aircraft overflights. Relatively few nest sites are expected to be affected, because nest sites are scattered at relatively low density over much of the planning area.

Winter aircraft flights associated with oil and gas operations should have no effects on spectacled or Steller's eiders. It is likely there will be minimal effects on eiders as a result of any summer aircraft flights over the marine environment, should any occur. Spectacled or Steller's eiders staging or migrating in coastal or offshore waters during the relatively brief staging/migration periods (late June/early July, late August/September) are not expected to experience significant disruption of foraging because of the low probability that these areas would be overflown by support aircraft.

Summer aircraft flights over onshore areas of the planning area, especially north and east of Teshekpuk Lake, may affect nesting females and their broods. The lake areas to the north, west, and east of Teshekpuk Lake are very sensitive areas to waterfowl during the summer months. The highest densities of spectacled eiders in the planning area are found in this area; they may use some of these lakes and other habitat in the area for breeding, nesting, and rearing their young. Because there will be no leasing in this area under this alternative, there should be no effects on spectacled eiders as a result of aircraft flights related to oil and gas activities in the planning area. Steller's eiders may use some of the lakes in the northern and central portions of the planning area for breeding, nesting, and broodrearing. Summer aircraft flights over the central portion of the planning area may affect breeding activities as well as nesting females and their broods. Nest sites are scattered at relatively low density over much of the planning area, so substantial disturbance of nesting or broodrearing eiders is not expected to occur. Some eiders may experience temporary, nonlethal effects, probably lasting less than an hour.

3) Effects from Vessel Activities: There may be some transportation of equipment and supplies through the marine environment during the open-water season. Due to logistics problems associated with moving materials over the long distances from existing infrastructure, barges may be used to transport heavy equipment and supplies. Staging areas may be established along the coastline and materials transported and stockpiled during the summer months (mid-July to early October) for operations at inland sites during the winter months. Spectacled and Steller's eiders staging or migrating in coastal or offshore waters during the relatively brief staging/migration periods (late June/early July, late August/September) are not expected to experience significant disruption of foraging because of the low probability of disturbance by barging activities.

4) Effects from Drilling Activities: Exploration-drilling activities will be conducted only onshore and only during the winter months, so spectacled eiders would not be affected by the activity. Table IV.A.1.b-5 provides information regarding the number of wells likely to be drilled and the timeframe for drilling, development, and production for the estimated range of resources (65-350 MMbbl) in the planning area. Because no leasing will occur in the northern portion of the planning area under this alternative, no drilling operations will be conducted in that area. There should be no effects on spectacled eiders as a result of drilling operations.

There should be no effects on Steller's eiders as a result of exploratory drilling operations in the remainder of the planning area, because drilling would be conducted during the winter. If a commercial discovery is made, drilling of production wells likely will proceed during the summer months. Noise from drilling activities in the summer may affect some breeding and nesting Steller's eiders, although such effects are unlikely and the number of birds affected likely would be very limited. Disturbance is likely to be limited to within a few kilometers from the activities; but some eiders may experience temporary, nonlethal effects, although effects could continue all summer. Affected eiders may respond to noise from drilling by relocating before nesting, abandoning the nest, or relocating the brood once incubation has been completed. During the development production phase, crew-support camps likely would be established. Improper containment or disposal of refuse could attract potential bird predators such as the arctic fox, grizzly bear, ravens, and glaucous gulls. It is possible that an increase in predators could result in the loss of eggs, chicks or even adult eiders.

5) Effects from Construction Activities: No pipeline-construction or other construction activities are expected to occur in the marine environment, so no effects on spectacled or Steller's eiders are expected in the marine environment. Onshore-pipeline-construction activities likely will occur in the winter and would not be likely to affect eiders. There should be no effects on spectacled or Steller's eiders as a result of onshore-pipeline-construction activities.

Vehicle traffic on road systems through the oilfields during the summer may affect spectacled and Steller's eiders. However, no leasing will occur in the northern portion of the planning area under this alternative, so spectacled eiders will not be affected by vehicle traffic. No summer road access to the oilfields in the remainder of the planning area is planned, so Steller's eiders should not be affected by vehicle traffic. Initial access will be by ice roads during the winter. If a discovery is made and development and production proceed, roads likely would be limited to the area between drill pads. In addition to vehicle traffic, there likely would be other activities occurring during the summer such as maintenance of roads and pads, construction of buildings, etc. Disturbance is likely to be limited to within a few kilometers from the activities. Because the density of Steller's eiders in the southern half of the planning area is very low, it is likely that the effects of vehicular traffic on Steller's eiders will be minimal, affecting at most a few nesting birds.

6) Effects from Spill Cleanup: No spills are expected to occur in the marine environment. In the event of an oil spill in the planning area, it is likely that the spill will be contained onshore. It is unlikely that any oil spilled onshore will be released into the marine environment. If oil is spilled onshore, personnel, equipment, and aircraft will be present to conduct cleanup operations. No oil-spill-cleanup activities would occur adjacent to the coast in the area of highest eider density, because no leasing will occur in the northern portion of the planning area under this alternative. There should be no effects on spectacled eiders as a result of oil-spill-cleanup activities. If oil-spill-cleanup activities occurred adjacent to Steller's eider breeding, nesting, or rearing areas, limited disturbance and possible displacement of eiders from their normal activities could occur. Due to the relatively small size of spills, the limited area affected by a spill, and the limited likelihood for a spill to occur near an eider-nesting area, it is likely that only a few eiders may be displaced from favored habitats or otherwise be affected by these activities.

(c) Effects of Spills: Exposure of spectacled and Steller's eiders to oil is expected to result in the general effects (i.e., individuals are not expected to survive moderate to heavy contact) noted in Section IV.B.6.c of the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a).

Under this alternative there would be no leasing in the northern portion of the planning area. No spills are expected to occur in the marine environment, nor is it likely that any oil spilled onshore will be released into the marine environment. Therefore, eiders occupying marine habitats during summer/fall periods for staging/migrating should not be at risk. Onshore spills would not occur in the northern portion of the planning area in primary eider habitat. There should be no effects on spectacled eiders as a result of oil spills. If an oil spill occurred in the remainder of the planning area it is likely that few, if any, Steller's eiders would be contacted. Onshore spills are generally fairly small; consequently, the affected area would be fairly small and 65 to 80 percent of the spills are likely to occur on the drilling pad, where they would be unlikely to affect eiders. Those spills that occur on or reach the surrounding environment generally cover a small area (<500 ft^2).

Summary: Under Alternative B, spectacled eiders are not expected to be affected by oil and gas activities such as discharges, seismic surveys, drilling, oil-spill-cleanup activities, construction activities, vehicle traffic, or oil spills. Steller's eiders are not expected to be affected by oil and gas activities such as discharges, seismic surveys, most construction activities, or oil spills. Neither spectacled nor Steller's eiders staging or migrating in the marine environment along the Beaufort Sea coast are expected to experience adverse effects from noise or disturbance from marine-vessel traffic or aircraft traffic associated with activities under this alternative. Spectacled eiders breeding, nesting, or rearing young in coastal habitats occasionally may be overflown by support aircraft and may experience temporary, nonlethal effects, probably lasting less than an hour. Steller's eiders breeding, nesting, or rearing young in the central portion of the planning area may be overflown by support aircraft, disturbed by noise from drilling or vehicular traffic during development/production activities in the summer, or affected by oil-spill-cleanup activities and may experience temporary, nonlethal effects, lasting probably less than an hour but possibly continuing all summer, in the case of summer drilling operations. It is unlikely that the primary Alaskan nesting area, located south and southeast of Barrow, would be affected much by these activities; significant disturbance of nesting or broodrearing eiders is not expected to occur. These eiders may experience temporary, nonlethal effects as described under Alternative A. Improper containment or disposal of refuse at support camps could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adult eiders.

Some eiders may be affected by activities associated with the management plan other than oil and gas activities, such as hazardous- and solid-material removal and remediation and summertime aircraft flights over sensitive areas that may affect nesting females and their broods. Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake may be overflown by aircraft (both helicopters and fixed-wing) on a regular basis during the summer months and may experience temporary, nonlethal effects as described in Alternative A. Due to the relatively low density of eiders in the area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

Conclusion—First Sale: Overall, bowhead whales exposed to noise-producing activities such as marine vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Bowheads may exhibit temporary avoidance behavior in response to vessel and aircraft activities. In general, bowheads do not appear to travel more than a few kilometers in response to a single disturbance incident. Behavioral changes as a result of exposure to vessel or aircraft traffic likely will last only a few minutes after the disturbance has left the area or the whales have passed. Overall, spectacled and Steller's eiders are not expected to be exposed to most noise-producing activities from oil and gas operations. Any effects from exposure likely would be minimal. Spectacled and Steller's eiders breeding, nesting, or rearing young in coastal habitats may be overflown by support aircraft and may experience temporary, nonlethal effects, probably lasting less than an hour. In the central portion of the planning area, Steller's eiders occasionally may be overflown by support aircraft, disturbed by noise from drilling or vehicular traffic during development/production activities in the summer, or affected by oil-spill-cleanup activities and may experience temporary, nonlethal effects lasting probably less than an hour but possibly continuing all summer in the case of summer drilling operations. It is unlikely that the primary Alaskan nesting area, located south and southeast of Barrow, would be affected much by these activities; so significant disturbance of nesting or broodrearing eiders is not expected to occur. Improper containment or disposal of refuse at support camps could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adult eiders. Some eiders may be affected by activities associated with the management plan other than oil and gas activities, such as hazardous- and solid-material removal and remediation and summer aircraft flights over sensitive areas. Nesting females and their broods may experience temporary, nonlethal effects as a result of these activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative B increases from a range of 65 to 350 MMbbl in zero to one oilfields (Table IV.A.1.b-4) to a range of 90 to 500 MMbbl in zero to two oilfields (Table IV.A.1.b-6). Resources at the low end of the resource range (90 MMbbl) are not economically viable as stand-alone fields. The number of exploration wells increase from a maximum of 4 to 14, delineation wells increase from a maximum of 6 to 12, and production wells increase from a maximum of 83 on 2 pads to 150 on 4 pads. Pipeline miles increase from 75 to 90 mi (Tables IV.A.1.b-5 and 7). Multiple sales would occur over a longer period of time and, depending on the frequency of sales and results from exploratory drilling operations, possibly increase the timeframe for oil and gas activities in the planning area by a couple of decades.

For Alternative B, it is estimated that the number of spills <1 bbl would increase from a range of 0 to 53 spills to a range of 0 to 75 spills, and the number of spills >1 bbl would increase from a range of 0 to 17 spills to a range of 0 to 25 spills over the assumed production life of the planning area (Tables IV.A.2-3a and IV.A.2-3b). The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 0 to 70 spills to a range of 0 to 100 spills (Tables IV.A.2-2a and IV.A.2-2b). Information pertaining to oil spills can be found in Section IV.A.2.

Conclusion—Multiple Sales: Effects of multiple sales are expected to be essentially as described above for the first sale. Bowhead whales exposed to noise-producing activities such as marine-vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Spectacled and Steller's eiders are not expected to be exposed to most noise-producing activities from oil and gas operations, and any effects from exposure likely would be minimal. The assumptions that oil spills would be relatively small in size, that the majority of the spills would occur on pads, and that small areas would be affected where spills occur off the pads would remain the same as for the first sale. Therefore, the effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the single sale.

Effectiveness of Stipulations: No stipulations or other special mitigating measures are anticipated to protect bowhead whales. Section II.C.7 contains stipulations proposed by BLM to protect various waterfowl species from various activities in the planning area. Stipulations included under several categories, such as solid- and liquid-waste handling, hazardous-material disposal and cleanup, ice roads and water use, overland moves and seismic work, oil and gas exploratory drilling, facility design and construction, ground transportation, air traffic, oilfield abandonment, orientation program, and other activities should provide adequate protection to eiders from most activities. The effectiveness of mitigating measures for noise and disturbance from aircraft traffic associated with activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, are the same as Alternative A. Aircraft traffic associated with activities other than oil and gas has the potential to affect breeding and nesting eiders, because several of the aircraft stipulations pertaining to flight-timing restrictions apply only to oil and gas activities. Therefore, the stipulations associated with flight-timing restrictions of aircraft probably are not adequate to protect spectacled eiders and Steller's eiders from disturbance from aircraft associated with aerial wildlife surveys and other surveys conducted in the lake areas to the north, west, and east of Teshekpuk Lake. Steller's eiders in other portions of the planning area are less likely to be affected by aircraft flights, because fewer flights are likely to be conducted in those areas. Disturbance of some individuals over the life of the project is expected to be unavoidable.

c. Effects of an Oil Spill on Listed and Proposed Listed Species along the Transportation Route: This section includes an analysis of the effects of oil spills along transportation routes on species discussed in Section III.B.6. A number of listed and proposed species were discussed in previous consultations, as described in the consultation information presented in the lead paragraphs under Alternative A. This discussion concerns only additional species not included in previous consultations. These species include seventeen salmonids identified by NMFS: the Snake River sockeye salmon; Snake River spring, summer, and fall chinook salmon; southern Oregon/northern California coast coho salmon; central California coast coho salmon; Sacramento River winter-run chinook salmon; Umpqua River cutthroat trout; and ten steelhead ESU's. Two steelhead ESU's that are listed as candidate species also are included. Also included are three species under the jurisdiction of the FWS—the tidewater goby, Sacramento splittail, and Suisun thistle. Because the consultation process has not been completed, additional species may be added in the final EIS. Other species along transportation routes were discussed in previous EIS's, and potential effects are summarized in Section IV.B.10. This EIS analyzes potential effects on species from a tanker oil spill along the transportation route from Valdez to ports along the U.S. West Coast. The average tanker spill is approximately 30,000 bbl, although most are smaller. The average spill size was increased as a result of the *Exxon Valdez* Oil Spill (EVOS). Based on Table IV.A.2-5a, the estimated mean number of spills under Alternative B ranges from 0 to 0.39, while the estimated mean number of spills under Alternative E ranges from 0.28 to 1.21. The most likely number of spills to occur resulting from NPR-A resources is zero spills under Alternatives B through D and one spill under Alternative E over the assumed production life of the NPR-A. There is a 24- to 70-percent chance that one or more spills ≥1,000 bbl will occur under Alternative E over the assumed life of the IAP.

Under the multiple-sales approach, the estimated mean number of spills under Alternative B increases to a range of 0 to 0.55, while the estimated mean number of spills under Alternative E increases to a range of 0.55 to 2.42 (Table IV.A.2-5b). The most likely number of spills to occur resulting from NPR-A resources is zero spills under Alternatives B and C and increases to one spill under Alternative D and two spills under Alternative E over the assumed production life of the IAP. There is a 42- to 91-percent chance that one or more spills ≥1,000 bbl will occur under Alternative E over the assumed life of the IAP.

(1) Salmonids: Contact with sufficient concentrations of spilled oil may affect fish populations in several ways: (1) eggs and larvae may suffer increased mortality due to coating or direct toxic effects; (2) adults may fail to reach spawning grounds in critical, narrow, or shallow contaminated waterways; (3) fecundity or spawning behavior may change; (4) local food species of the adults, juveniles, fry, or larvae may be adversely affected or eliminated; and (5) sublethal effects may reduce fitness and affect the ability to endure environmental perturbations. However, concentrations of petroleum hydrocarbons (PHC's) are toxic to fishes only a short distance from, and for a short time after, a spill event (Malins, 1977). Available information indicates that concentrations of PHC's found beneath an oil slick are <0.1 ppm. This is well below toxic levels for fish eggs and larvae (sublethal effects on eggs, larvae, and adults at 0.01-1.0 ppm; lethal effects on eggs and larvae at 0.1 to 1.0 ppm, and on adults at 1 to 100 ppm) (Malins, 1977; Meyer, 1990).

There is some evidence that pelagic fishes (salmon) are able to detect and avoid hydrocarbons in the water (Weber, et al., 1981), although some salmon may not completely avoid oiled areas and, if exposed to sublethal amounts of spilled oil, may become temporarily disoriented; but they would eventually return to their home stream (Martin, 1992). Adult salmon appear to be relatively unaffected by oil spills and are able to return to natal streams and hatcheries even under very large oil-spill conditions, as evidenced by pink and red salmon returning to Prince William Sound and red salmon returning to Cook Inlet after the EVOS. Eggs of pelagic fish that spawn upstream in rivers and streams, such as the salmonids referenced above, would be unaffected by an oil spill. Potential effects on outmigrating smolts are less clear. Based on Malins (1977), some smolts may experience sublethal effects if a large oil spill occurred in the mouth of the river, bay, or estuary during the time that outmigrating smolts reached that area. This probably is an unlikely scenario.

It also has been suggested that the EVOS caused a reduction in food available to pink salmon populations in Prince William Sound, and that this has caused reduced survival and subsequent failures in pink salmon runs. Studies examining growth, survival, and availability of prey for juvenile pink salmon have produced conflicting results. One study examined juvenile pink and chum salmon contaminated by ingesting EVOS crude in 1989 (Wertheimer et al., 1993). Oil was present in 1 percent and 3 percent of these salmon, respectively, that were collected at oiled sites in 1989; but there was no evidence of oil contamination in these same areas in 1990. Juvenile salmon were more abundant in unoiled areas, and this difference continued in 1990 after oil-exposure levels diminished. The observed difference was attributed to geographic differences in production and migration rather than oil exposure. The diet composition and feeding efficiency of these fish was unaffected by the oil spill. Juvenile pink salmon were smaller and slower growing in oiled areas in 1989 but not in 1990. There was no evidence of a reduction in available prey to pinks and chums in oiled areas in 1989 or 1990. The slower growth of pink salmon juveniles in 1989 was attributed to the metabolic cost of depurating the hydrocarbon burden. The slower growth may have caused an incremental reduction in survival to adulthood.

Overall, the potential for an oil spill to affect these species seems limited. Tanker routes usually pass well offshore of the coast, unless the tanker is approaching or entering a port. In the event that an oil spill occurred and coincided with the outmigration of smolt, some smolts could be exposed to spilled oil. If this occurred, an oil spill could cause slower growth for smolts, which could result in an incremental reduction in survival to adulthood but probably would not result in population-level effects.

(2) Tidewater Goby: No information is provided in 59 *FR* 5494 concerning the potential effects of an oil spill on tidewater gobies, in spite of the numerous oil tankers transporting oil along the coast of California. Coastal development projects that result in the loss of coastal saltmarsh habitat currently are considered the major factor adversely affecting the tidewater goby. This includes activities such as draining marsh habitat, dredging waterways, channelization, changes in salinity and temperature, discharge of agricultural and sewage effluents, etc. The potential for an oil spill to affect this species seems limited. Tanker routes usually pass well offshore of the coast unless the tanker is approaching or entering a port. The tidewater gobies are discontinuously distributed along the coast of California in tidal streams associated with coastal lagoons, and they are found at the upper end of those lagoons in low- salinity water. In the event of an oil spill occurring near one of these coastal lagoons, it may be possible to place booms across the openings of many of these lagoons and prevent oil from reaching the goby's habitat. If an oil spill did reach the upper portions of a lagoon, it could adversely affect these fish by causing further degradation of their habitat. Tidewater gobies could be adversely affected at the population level due to limited availability of suitable habitat, low population size, and their restricted ability to recolonize habitats from which they have been extirpated. In general, the potential for adverse effects on this species is considered low.

(3) Sacramento Splittail: No information is provided in 59 *FR* 862 concerning the potential effects of an oil spill on the Sacramento splittail in spite of the numerous oil tankers transporting oil along the coast of California. A variety of factors affect the estuarine ecosystems that have led to a decline of the Sacramento splittail. The principal factor mentioned was the altered hydraulics and reduced outflow of the delta caused by export of freshwater from the Sacramento and San Joaquin rivers. Threats to the species include reduced river outflow, loss of spawning and nursery habitat, urban and agricultural pollution, introduction of exotic species, etc. The potential for an oil spill to affect this species seems limited. Tanker routes usually pass well offshore of the coast, unless the tanker is approaching or entering a port. The Sacramento splittail occurs only in the Suisun Bay and the San Francisco Bay-Sacramento-San Joaquin river estuary. The potential for an oil spill to reach these areas is very low. In the event of an oil spill occurring near these areas, it may be possible to place booms across the openings of many of these lagoons, preventing oil from reaching the Sacramento splittail's habitat. If an oil spill did reach these areas, it could adversely affect these fish by causing further degradation of their habitat. The Sacramento splittail could be adversely affected at the population level due to limited availability of suitable habitat and low population size. In general, the potential for adverse effects on this species is considered low.

(4) Suisun Thistle: Information is provided in 59 *FR* 862 concerning factors that may affect the Suisun thistle. A variety of factors affect the estuarine ecosystems that have led to a decline of the Suisun thistle. Habitat has been severely reduced due to hydraulic mining, diking, and filling involved in agricultural land conversion and urbanization, waste disposal, port and industrial development, railroad construction, dredging, salt production, sedimentation, etc. The potential for an oil spill to affect this species seems limited. Tanker routes usually pass well offshore of the coast, unless the tanker is approaching or entering a port. The Suisun thistle occurs only in salt or brackish tidal marshes within the San Francisco Bay area. The potential for an oil spill to reach these areas is very low. In the event of an oil spill occurring near these areas, it may be possible to place booms across the openings of many of these lagoons, preventing oil from reaching the Suisun thistle's habitat. The plant would likely be vulnerable only on a high tide. If an oil spill did reach these areas, it could adversely affect this species by smothering the plants and causing further degradation of their habitat. The Suisun thistle could be adversely affected at the population level due to limited availability of suitable habitat and low population size. In general, the potential for adverse effects on this species is considered low.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: For Alternative B, recreation-field employment is generated by 30, 1-week duration float-trip parties per year (Table II.H.3.b), equal to one person for 8 months each year.

b. Oil and Gas Exploration and Development Activities: Increased revenues and employment are the most significant economic effects that would be generated by Alternative B. Increased property-tax revenues and new employment would be created with the construction, operation, and servicing of facilities associated with oil and gas activities. These facilities are described in Table IV.A.1-1 and are summarized as follows. For exploration, 1 to 4 exploration and 0 to 6 delineation wells would be drilled between 2000 and 2006; for development, 0 to 83 production and service wells would be drilled, 0 to 2 production pads constructed, and 0 to 75 mi of onshore pipeline installed between 2006 and 2015. The number of workers needed to operate the infrastructure is determined by the scale of the infrastructure and not by the amount of oil produced. A wide range of production volume can be handled by a given level of infrastructure. Once the infrastructure is constructed, the number of workers needed to operate it does not depend on the amount of product flowing through it. Effects include employment generated by seismic surveys during exploration. State property-tax revenues are in proportion to the value of onshore facilities. State royalty income and State severance tax are in proportion to production. Peak yearly production is estimated at 0 to 35 MMbbl. (For complete descriptions of resources and associated activity, see Sec. IV.A.1.b).

(1) North Slope Borough Revenues and Expenditures: Potential revenues will be determined by several different factors; therefore, the revenue projections should be considered with the understanding that many uncertainties exist. Exploration, development, and production are projected to generate increases in property taxes above the levels without Alternative B activities starting in 2000 and averaging about 0 to 2 percent each year through the production period, or about $0 to $3 million. This will decline over the period of oil and gas activity due to depreciation of the infrastructure. The two expenditure categories that affect employment—operations and the Capital Improvements Program (CIP)—are projected to decline without oil and gas activity. Of these two categories, it is assumed that only expenditures on operations would be affected by the effects of oil and gas activity on taxable property value. Those CIP expenditures that have generated many high-paying jobs for residents would not be changed by oil and gas activity.

(2) North Slope Borough Employment: The gains from Alternative B in direct employment would include jobs in petroleum exploration, development, and production and jobs in related activities (Table IV.C.11-1). For oil at a price of $18/bbl, exploration would occur in one year only, 2000, and employment would be 99 direct jobs. At $18/bbl, any resources discovered would not be economically viable as stand-alone fields (Table IV.A.1.b-4). At $30/bbl, direct employment is anticipated to peak at 1,500 jobs during the development phase and decline to a level of 700 during production from 2015 to 2028. All of these jobs would be filled by commuters who would be present at the existing enclave-support facilities in and near the Prudhoe Bay complex approximately half of the days in any year. Most workers would commute to permanent residences in the following three regions of Alaska: Southcentral, Fairbanks and, to a much smaller extent, the North Slope. Some workers would commute from the

Table IV.C.11-1
Summary of Employment Forecasts, Alternative B

	IAP Employment in Enclave			NSB Resident Employment		
	Without IAP Activity	With IAP Activity		Without IAP Activity	Increase with IAP Activity	
Year		$18/bbl	$30/bbl		$18/bbl	$30/bbl
1999	0	0	0	1,865	0	0
2000	0	99	99	1,825	0	2
2001	0	0	179	1,794	0	8
2002	0	0	179	1,767	0	12
2003	0	0	199	1,746	0	13
2004	0	0	139	1,730	0	13
2005	0	0	349	1,716	0	14
2006	0	0	1,421	1,701	0	44
2007	0	0	727	1,685	0	42
2008	0	0	729	1,662	0	18
2009	0	0	1,541	1,614	0	32
2010	0	0	933	1,565	0	19
2011	0	0	970	1,513	0	25
2012	0	0	819	1,470	0	27
2013	0	0	909	1,431	0	30
2014	0	0	853	1,393	0	30
2015	0	0	740	1,357	0	24
2016	0	0	700	1,350	0	24
2017	0	0	700	1,330	0	24
2018	0	0	700	1,310	0	24
2019	0	0	700	1,290	0	24
2020	0	0	700	1,290	0	24
2021	0	0	700	1,310	0	24
2022	0	0	700	1,330	0	24
2023	0	0	700	1,350	0	24
2024	0	0	700	1,370	0	24
2025	0	0	700	1,390	0	24
2026	0	0	700	1,410	0	24
2027	0	0	700	1,430	0	24
2028	0	0	700	1,450	0	24

Sources: Resident employment 1999–2015, Rural Alaska Model, North Slope Borough, 1996. IAP employment and resident employment 2016–2028, Manpower Model and MMS.

Table IV.C.11-2
Summary of NSB Population Forecasts, Alternative B

Year	Resident Population No IAP Activity	Increase in Resident Population IAP Activity $18/bbl	Increase in Resident Population IAP Activity $30/bbl	Year	Resident Population No IAP Activity	Increase in Resident Population IAP Activity $18/bbl	Increase in Resident Population IAP Activity $30/bbl
1999	6,067	0	0	2014	6,582	0	90
2000	6,134	0	6	2015	6,423	0	72
2001	6,213	0	24	2016	6,300	0	72
2002	6,301	0	36	2017	6,200	0	72
2003	6,391	0	29	2018	6,100	0	72
2004	6,488	0	29	2019	6,000	0	72
2005	6,684	0	42	2020	6,000	0	72
2006	6,695	0	132	2021	6,100	0	72
2007	6,820	0	126	2022	6,200	0	72
2008	6,918	0	54	2023	6,300	0	72
2009	7,011	0	96	2024	6,400	0	72
2010	7,050	0	57	2025	6,500	0	72
2011	7,004	0	75	2026	6,600	0	72
2012	6,891	0	81	2027	6,700	0	72
2013	6,743	0	90	2028	6,830	0	72

Sources: For years 1999–2015, Rural Alaska Model, North Slope Borough, 1996. For 2016–2028, MMS.

enclaves to permanent residences outside Alaska, especially during the exploration phase.

Because of the development of facilities or the continued use of facilities that are taxable by the NSB, the NSB will have additional revenues that most likely will be used for ongoing operations. This in turn results in NSB-government jobs, which are a large proportion of the increases in NSB resident employment generated by this alternative.

At $18/bbl, there would be no change in NSB resident employment for any year. At $30/bbl, total resident employment is anticipated to increase by 44 jobs in the peak of development and level off to 24 in the production phase after 2014 (Table IV.C.11-1). Peak increases in resident employment are about 3-percent greater with Alternative B than without during the development phase and about 2-percent greater during production. The increase in employment opportunities partially may offset declines in other job opportunities and delay expected outmigration. Increases in resident population will correspond to increases in employment (Table IV.C.11-2).

The employment and population forecasts were calculated using the Manpower Model, created by MMS, and the Rural Alaska Model (RAM) for the NSB, created and updated by the Institute for Social and Economic Research (ISER) of the University of Alaska Anchorage (UAA) (Tables IV.C.11-1 and IV.C.11-2). Using the Development Scenario in Section IV.A.1.b and associated levels of activities, the numbers of wells, platforms, shore bases, and kilometers of pipeline are input to the Manpower Model. The Manpower Model predicts the number of direct oil-industry workers. These data are then input to the RAM. Among other variables, the RAM predicts the resident workers in the NSB (which in this case is indirect employment) and resident population. The terms "job" and "employee" are used in this section to mean one full-time-equivalent worker working for 1 year. A "resident worker" is defined as a resident of the NSB.

Jobs working directly for the oil industry for activities associated with Alternative B also will be available. However, the number of NSB—resident Natives working directly for oil companies in and near Prudhoe Bay historically has been low—approximately 60 out of more than 6,000 workers, or about 1 percent (UAA, ISER, 1993). While the proposed oil and gas activity is projected to generate a large number of direct oil-industry jobs in the region, the number of jobs filled by permanent NSB Native residents is not projected to be large. It is assumed NSB resident Natives will hold approximately 1 percent of the oil-industry jobs, based on historical experience.

No workers will be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

(3) Effects of Subsistence Disruptions on the North Slope Borough Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents primarily through the direct loss of subsistence resources. See Section IV.C.13 for effects on subsistence-harvest patterns.

(4) State Revenues: State revenues will increase as a result of Alternative B. Property-tax revenues to the State will be approximately 25 percent of the revenues to the NSB, or $0 to $0.75 million annually. State royalty income will be in proportion to production, or approximately $0.25 million for each 1 MMbbl of oil produced and flowing through the TAPS, or $0 to $4 million annually. State severance tax will be half that amount, or $0 to $2 million annually. For these ratios and a more detailed explanation for the above analysis, please see *Alaska Statewide and Regional Economic and Demographic Systems: Effects of OCS Exploration and Development, 1990* (UAA, ISER, 1990).

(5) Southcentral Employment: Workers in the enclave centered at Prudhoe Bay probably would commute to permanent residences in Southcentral Alaska, Fairbanks, and outside the State. However, for the purpose of this analysis, it is assumed all of the enclave workers (Table IV.C.11-1) commute to Southcentral and have permanent residences there except during peak construction years. Every enclave worker generates approximately five additional jobs, and these are assumed to be located in Southcentral, mostly in the trade, finance, and service sectors. This is a result of spending by enclave workers, who have higher than average wages, which has a multiplier effect on the economy and generates additional employment.

At $18/bbl, direct employment would occur in one year of exploration only, 2000, at 99 jobs. Because of the brief and limited number of jobs, it is assumed no indirect jobs or additional population would be created in Southcentral Alaska.

At $30/bbl, population in Southcentral generated directly and indirectly by enclave workers during production will be 10,500, or 2.4 percent of the Southcentral population of 434,000 anticipated without the IAP in 2015. In the 7-year period of the exploration and development phases, the population directly and indirectly associated with Alternative B would rise to the level sustained during production. Population associated with workers, that is, families of workers, is at a ratio of approximately 2.5 persons for each worker. The population for Southcentral without the IAP is assumed to be 370,000 in 1999 and increase at a rate of 1 percent per year, resulting in a population of 434,000 in 2015. In 1995, the population for Southcentral was 356,000, of which 258,000 were in Anchorage, 51,000 in the Matanuska-Susitna Borough, and 47,000 in the Kenai Peninsula Borough (State of Alaska, Department of Community and Regional Affairs [DCRA], 1996). In the two peak construction years, approximately half of the construction workers are assumed to commute from outside Alaska to the North Slope and spend little time in Anchorage. This assumption has a leveling effect on the increase in workers and population in Southcentral Alaska. Employment and population ratios in the above analysis are derived from UAA, ISER, 1990.

Conclusion—First Sale: For activities other than oil and gas exploration and development, Alternative B would generate approximately 50 jobs for 4½ months associated with seismic surveys and recreation employment, equivalent to one person working 8 months per year. For oil and gas exploration and development activities, production under Alternative B is projected to generate increases above the levels of Alternative A as follows—SB property taxes, 0 to 2 percent ($0-$3 million); direct oil-industry employment, 0 to 700 (5x this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 0 to 2 percent; and annual revenues to the State of $0 to $0.75 million, $0 to $4 million, and $0 to $2 million from property tax, royalty income, and severance tax, respectively.

Multiple Sales: The effect of multiple sales for Alternative B is projected to be approximately two times that of the First Sale for Alternative B.

Conclusion—Multiple Sales: The effect of multiple sales for Alternative B is projected to be approximately two times that of Alternative B.

Effectiveness of Stipulations: There are no mitigating measures that would change potential economic effects.

12. Cultural Resources:

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration And Development: Cultural resources (the physical remains resulting from the activities of historic or prehistoric humans) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative B, the management-action impacts generally are the same as under Alternative A, except the intensity of the actions may increase due to potential oil and gas exploration activities in addition to seismic-data gathering.

(2) Oil and Gas Exploration and Development Activities: Cultural resources are not ubiquitous in the planning area as are wildlife and habitat, and their locations are much less predictable. As a result, it is quite possible that no oil and gas exploration or development activities would impact a cultural resources site.

(a) Effects of Disturbance from Exploration: The types of environmental conditions and the cultural resources that may be impacted by exploration activities would be the same as those described under Alternative A for activities other than oil and gas exploration and development.

Drilling 10 exploration/delineation wells is anticipated under Alternative B. No more than two wells are expected to be drilled during a single winter season. Drilling the 10 wells probably would occur over the span of several winter seasons using drill pads, camp pads, roads, and airstrips made of ice and snow. Because no permanent pads, roads, or airstrips would be constructed and therefore no significant disturbance of the ground surface would occur, buried cultural resources should not be measurably impacted. On the other hand, cultural resources on or incorporated in the ground's surface could be significantly impacted by ice- and snow-construction activities, while the integrity of aboveground cultural structures certainly would be compromised. The only significant surface/subsurface disturbance that would occur as a result of the actual drilling would be the drill hole itself.

(b) Effects of Exploration Spills: Sixty-five to eighty percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. Therefore, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions where cleanup is less invasive than in a summertime terrestrial spill. The actual spilling of hydrocarbons on a cultural resources site, in most cases, would have limited impact. However, spill cleanup may pose a serious threat to the integrity of a site, perhaps resulting in its destruction.

(c) Effects of Disturbance from Development: The construction of two production pads (connected by a road), one airstrip, and 75 mi of pipeline is anticipated under Alternative B. Surface disturbance resulting from this work would impact approximately 100 acres. Additional surface disturbance could occur, depending on the source of the material used to construct the pads, etc. Any cultural resources within the pad, road, and airstrip perimeters or located on the material borrow areas would be severely impacted or destroyed. It is anticipated that the pipeline would not have an associated all-weather road or pads and would be constructed during the winter months from an ice road and pads. Therefore, aside from the previously mentioned impacts associated with ice-pad construction, the only significant surface impact resulting from pipeline construction will be associated with the placement of VSM's and check valves. Any cultural resources at the location of VSM's or check valves will be severely impacted or destroyed. It is possible that a pump station would be necessary. A pump station would impact about 50 surface acres. The impacts associated with these types of activity easily could impact cultural resources, if any are present.

(d) **Effects of Development Spills**: Sixty-five to eighty percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad or the pipeline. The actual spilling of hydrocarbons on a cultural resources site, in most cases, would have limited impact, especially if the spill occurs when the ground is snow-covered and frozen. However, spill cleanup may pose a serious threat to the integrity of the site, perhaps resulting in its destruction.

Conclusion—First Sale: Under Alternative B, impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to but of an increased magnitude from those of Alternative A. Under Alternative B, most of the potential impacts to cultural resources would result from oil and gas exploration and development.

Multiple Sales: Under Alternative B, potential impacts incrdease by a factor of two to four, depending on a suite of variable, including shared infrastructure. The scattered nature of cultural locales and the fact that the location of many remain unknown, make it somewhat difficult to assess the likelihood and severity of potential impacts.

Conclusion—Multiple Sales: Under Alternative B, potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative A, but the probability of impacts occurring might increase. Under Alternative B, the potential impacts to cultural resources from oil and gas exploration and development would increase dramatically compared to Alternative A, because only seismic activities are permitted under Alternative A.

Effectiveness of Stipulations: Along with the guidance (particularly in regard to inventory) in Sections 106 and 110 of the National Historic Preservation Act, Executive Order 11593, consultation with the SHPO, and the NSB History, Language, and Culture Commission, the current clearance process and "standard" stipulation (#79) is adequate to protect cultural resources in the NPR-A through the leasing process. However, any postleasing activity engaged in by the lessee would require an action-specific NEPA document tiered off this or other EIS's. The protection of cultural resources in the planning area would follow the established and proven procedures developed by the BLM during the NPR-A exploration of the late 1970's and early 1980's.

13. Subsistence-Harvest Patterns: This section analyzes the impacts of ground-impacting-management actions and oil and gas leasing activity on the subsistence-harvest patterns of communities in or near the planning area. This analysis is organized by types of effects and discusses effects on subsistence-harvest patterns on each affected community as a result of disturbance and oil spills. Analytical descriptions of affected resources and species as well as indigenous Inupiat knowledge concerning effects are described in detail.

Under Alternative B, a maximum protection to surface resources would be emphasized by making unavailable to oil and gas leasing 2.61 million acres (2.04 million would remain available). The Teshekpuk Lake Watershed, Goose Molting Habitat, Spectacled Eider Nesting Concentrations, Teshekpuk Lake Caribou Habitat, and Fish Habitat LUEA's would be unavailable to oil and gas leasing. Leasing would be deferred on lands subject to pending Kuukpik Corporation conveyances. The Colville River would be recommended to be included in the WSR System and managed as such. The BLM's option to regulate motorized use of and access to the river could disrupt subsistence hunters' use of the upper Colville, and local opinion in Barrow and Nuiqsut clearly opposes such a designation.

Raptor, passerine, and moose areas on the Colville River, the Pik Dunes, Ikpikpuk Paleontological Sites, and recreation and scenic areas would be made unavailable to oil and gas leasing and subject to restrictions for siting pipelines and industrial structures.

The planning area includes the eastern half of Barrow's terrestrial subsistence-harvest area, the western half of Nuiqsut's terrestrial subsistence-harvest area, and the eastern edge of Atqasuk's terrestrial subsistence-harvest area crosses over the western boundary of the planning area (the Ikpikpuk River) (Sec. III.C.3).

As noted in Sections III.C.2 and 3, onshore oil developments at Prudhoe Bay already have affected the subsistence-harvest system. Many of these effects are the indirect result of increased wage employment made available through projects and services funded by the NSB. Wage employment has led to an upgrading of hunting

364

technology but, alternatively, has constricted the total time available for hunting. Additionally, Prudhoe Bay development has restricted access to traditional hunting areas in the vicinity. Currently, diminished household incomes, reduced by the loss of high earnings from NSB CIP activity in the early to mid-1980's, tend to encourage subsistence activity and to foster an increase in harvest levels and an expansion of subsistence-harvest areas for many subsistence resources (Pedersen, 1997).

Access to subsistence resources, subsistence hunting, and the use of subsistence resources could be affected by reductions in subsistence resources and changes in subsistence-resource-distribution patterns. These changes could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities that include pipeline construction; structure placement; and support-base, pump-station, and road construction. The following analysis examines the effects of these disturbance agents on the communities near the planning area, with specific information on the subsistence resources harvested by the Inupiat living in these communities. This analysis discusses impacts on the terrestrial resources harvested by the residents of Barrow, Atqasuk, and Nuiqsut.

The factors affecting the subsistence-harvest patterns of Barrow, Atqasuk, and Nuiqsut are summarized as follows:

- Heavy reliance on caribou in the annual average harvest for Barrow (22-58% of the total subsistence harvest), Atqasuk (57%), and Nuiqsut (30-37%) (see Table III.C.4-3; Stoker, 1983, as cited by Alaska Consultants, Inc. (ACI)/Braund, 1984; Stephen R. Braund 1989b; State of Alaska, Dept. of Fish and Game (ADF&G) 1995d; Stephen R. Braund and Associates and ISER, 1993b; Pedersen, 1995a, 1995b; Stephen R. Braund and Associates, 1996; Brower and Opie, 1997; Opie, Brower, and Bates, In prep.).
- Heavy reliance on bowhead whales in the annual average harvest for Barrow (21-38%) and Nuiqsut (4-38%) (see Table III.C.2-4; Stoker, 1983, as cited by ACI/Braund, 1984; Stephen R. Braund and Associates 1989b; ADF&G, 1995d; NSB Planning Dept., 1993; Kaleak, 1996; Brower and Opie, 1997). Percentages have continued to rise, because IWC quotas have almost doubled in recent years.
- Reliance on fish in the annual average harvest for Barrow (6-7%), Atqasuk (37%), and Nuiqsut (44-33%), (see Table III.C.2-4; Stephen R. Braund and Associates 1989b; ADF&G 1995d; Brower and Opie, 1997; Opie, Brower, and Bates, In prep.).
- Hunting ranges overlap for many species harvested by Barrow, Atqasuk, and Nuiqsut.
- Hunting and fishing are cultural values that are central to the Inupiat way of life and culture.
- In 1990, the population of Barrow was 3,469; Atqasuk, 216; and Nuiqsut, 354. In 1997, the Alaska Dept. of Labor estimates were 4,276 for Barrow, 233 for Atqasuk, and 435 for Nuiqsut (ADF&G, 1995d; State of Alaska DCRA, 1997).

Effects Agents: The agents associated with management actions and oil and gas leasing in the planning area that could affect subsistence resources and subsistence-harvest patterns are impacts from disturbance and oil spills from activities other than oil and gas exploration and development and from oil and gas exploration and development activities.

Effects Definitions and Effects Levels: The assessment of effects levels derives from a set of effects-level definitions that have been developed over many years by MMS anthropologists and socioeconomic specialists and that have withstood many professional and legal reviews. These definitions follow a two-tiered approach in that they account for effects to subsistence resources as well as effects to subsistence harvests. Disturbance to subsistence is measured by duration of effect to resources and harvests and by changes in availability, in desirability, and in population levels of resources. The definitions used in this analysis consider periodic (short-term) effects to resources that have no consequent effects to harvests as the lowest level of effect (very low effect). The next level of effect has resources being affected for a period up to 1 year (1 harvest season), but none of these resources would become unavailable, undesirable, or experience population reductions and, therefore, would not alter subsistence harvests (low effect). The third gradation of effect has resources becoming unavailable, undesirable for use, or experiencing population reductions for a period up to 1 year (1 harvest season), with subsistence harvests being affected for that period (moderate effect). The next level of effect is similar to the previous definition, except resources would become unavailable, undesirable for use, or experience population reductions for a period from 1 to 2 years (2 harvest seasons) with subsistence harvests affected for a longer period (high effect). The highest level of effect defined again follows the structure of the previous two effects levels with resources becoming unavailable, undesirable for use, or experiencing population reductions for a period from 2 to 5 years (5 harvest seasons) with subsistence harvests affected for a much longer period (very high effect).

Disturbance: The noise-producing exploration and construction activities of seismic surveys, aircraft traffic, vessel traffic (supply vessels), and construction activities are those most likely to produce disturbance effects to subsistence species that include bowhead whales, belukha whales, caribou, fish, seals, walrus, and birds. A more detailed narrative of the effects from these activities on important subsistence species can be found in Section IV.B.10 of the Beaufort Sea Sale 144 Final EIS (USDOI, MMS, 1996a) and is summarized and incorporated here by reference.

Disturbance effects would be associated with aircraft and vessel noise, construction activities, and oil spills; specifically: (1) seismic surveys that occur prior to an oil and gas lease sale (if there is a decision to hold a lease sale); (2) aircraft support of exploration and development activities; (3) possible vessel supply and support of exploration and development activities; (4) drilling activities during the exploration and development and production phases; and (5) onshore construction, including pipeline, road, support-base, landfall, and pump-station construction. Noise and traffic disturbance would be a factor throughout the life of the IAP.

Disturbance from construction activities could cause some animals to avoid areas in which they normally are harvested or to become more wary and difficult to harvest. The latter could be a concern during the bowhead whale migration offshore, although possible supply-barge traffic to coastal staging areas likely would occur during the summer when whales are not present and tend to follow a nearshore route. Current Western scientific research indicates bowheads do not seem to travel more than a few kilometers out of their original swimming direction due to noise-disturbance events, and that these changes in swimming direction are temporary, lasting from a few minutes for aircraft and vessel noise to up to 1 hour in response to seismic activity. Traditional Inupiat testimony often does not agree with the conclusions of Western science, contending that whales are affected by noise at greater distances and alter their swimming directions for longer periods. In some instances, as in the case of nesting birds, construction activities may decrease the biological productivity of an area. Restrictions may be placed on the use of firearms in areas surrounding new oil-related installations (such as roads, landfalls, and pipelines) to protect oil workers and valuable equipment from harm. Finally, structures such as pipelines may limit hunter access to certain active hunting sites.

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may affect subsistence resources and harvest patterns under Alternative B include aircraft use for point-to- point transport, wildlife and other aerial surveys, ground activities such as seismic surveys, resource inventories for paleontological and cultural excavations, research and recreational camps, and overland moves as well as guided hunting and river float parties on the Colville River from the headwaters to below Umiat. Hazardous- and solid-waste removal and remediation would continue to occur at abandoned drill sites. Only potential oil spills from fuel storage at construction sites and camps could occur, but the size of such spills is likely to be small (a few barrels) and areal contamination small. Cleanup activity is not likely to cause great disturbance to normal subsistence-harvest activities or the surrounding environment. As these are normal occurrences under the existing BLM management regime, little net change is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area. Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil exploration activities—seismic activity and exploration drilling—would occur in winter (early December to mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled, and moved inland the following winter. Seismic surveys would continue on the NPR-A if a leasing program occurs and typically would involve 1 to 2 crews of 60 persons each collecting approximately 5 to 10 line miles of seismic data per day. A typical operation would employ Vibroseis trucks, supply vehicles, and a supply train pulling a camp on skids that would provide living facilities for the crew. Under Alternative B, 0 to 1 fields with a resource range of 65 to 350 MMbbl of oil is estimated. One to 4 exploration wells would be drilled. For development, 0 to 6 delineation and 0 to 83 production and service wells could be drilled, as well as 75 mi of pipeline constructed. At $18 per barrel, Alternative B would not be an economically viable stand-alone field.

(a) Effects of Disturbance: During the exploration phase, facilities at Kuparuk and Prudhoe/Deadhorse would be used for air-support staging, where personnel and air freight would be transferred to aircraft. Two fixed-wing aircraft trips per week per drill unit are assumed for exploration. The existing facilities at Kuparuk and Prudhoe Bay are adequate to handle the projected needs during exploration. Air traffic through Barrow might increase, but no significant staging of equipment or personnel would occur from the community. During the development phase, facilities at Kuparuk and Prudhoe/Deadhorse also would be used for air-support staging, and air traffic would increase. Seismic and drilling activities would occur in the winter, as would transportation of construction equipment; in this way, disturbance to subsistence resources would be kept to a minimum.

(b) Effects of Spills and Spill Cleanup: The analysis for North Slope onshore spills indicates a record of chronic small spills, 65 to 80 percent of which occur on the drill pad. Twenty to 35 percent of these spills may occur on or reach areas off pad. Thirty-two percent of the crude-oil spills between 1989 and 1996 were $\leq$2 gal. Ninety-nine percent of the crude-oil spills were <25 bbl and, during the same period, no spills >1,000 bbl occurred. Of the spills that move off pad, generally coverage is <500 ft^2; spills that occur in winter contact snow, which is cleaned up before the tundra is contaminated.

Under Alternative B, one field with a resource range of 65 to 350 MMbbl of oil is estimated. Oil-spill-occurrence estimates over the assumed production life of the IAP range from 0 to 70 crude-oil spills, with a volume range from 0 to 280 bbl (average spill size equals 4 bbl). For spills >1 bbl, the range is from 0 to 17 spills. For TAPS spills resulting from NPR-A production, the number of spills ranges from 0 to five, with a volume ranging from 0 to 6 bbl. The oil-spill-occurrence estimate for TAPS tanker spills resulting from NPR-A resources is a 0 to 68-percent chance of 0 spills (with an average spill size of 30,000 gal) occurring. Zero to 162 refined-oil spills (diesel fuel, aviation fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil) with an estimated volume ranging from 0 to 112 bbl (average spill size equals 29 gal) are estimated. Historically, by volume, diesel fuels account for 75 percent of the refined-oil spills.

All NPR-A scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. Adequate data are not available to estimate a chance of such an occurrence. Records indicate four pipeline leaks, with the largest discharge being 125 bbl. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would affect substantially the subsistence harvest (Sec. IV.C.13, Subsistence).

Other industrial activities associated with oil development that could have an effect on subsistence-harvest patterns would be the result of cleanup if an oil spill did occur. In the event of a large spill contacting and extensively oiling habitats, the presence of hundreds of humans, boats, and aircraft would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters. Because oil spills estimated from NPR-A activities would be small, chronic events and normally be contained on the drill pad, effects from the spills themselves and potential disruption from cleanup activities would have little to no impact on subsistence resources and harvest patterns.

b. Effects on Subsistence Species:

(1) Terrestrial Mammals:

(a) Effects from Disturbance: The level of effects to terrestrial mammals due to noise, disturbance, and habitat alteration from oil and gas activities is expected to increase in the southern half of the planning area. Increased habitat alteration would include the development of one oilfield and a pipeline to the TAPS. Caribou of the Central Arctic and Teshekpuk Lake herds are expected to be disturbed and their movements delayed along the pipeline during periods of air overflights, but these disturbances are not expected to affect migrations and overall distribution. The Western Arctic Herd (WAH) is not expected to be significantly affected, because its calving range is located far to the west of the planning area. Surface, air, and foot traffic near oilfield facilities is expected increase under Alternative B and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly impact Arctic Slope populations (see Sec. IV.C.9).

Also to be noted is the disturbance to caribou from scientific study noted by Noah Itta in 1993 public testimony, where he related having to kill a caribou that was suffering from rubbing the hair and skin off its legs trying to get free of a radio collar (Kuvlum LOA Hearing Minutes, 1993). Pipelines can create physical barriers to subsistence access, making subsistence hunters' pursuit of caribou more difficult (Kruse et al., 1983). Additional pipelines built as a result of oil and gas activities in the planning area could disrupt the Nuiqsut subsistence caribou hunt to the extent the constructed pipeline and roads displaced caribou from traditional subsistence-hunting areas. Effects from disturbance to the harvests experienced by Nuiqsut, Barrow, and Atqasuk are expected to be short term, as their caribou harvests depend primarily on the Teshekpuk Lake Herd that is expected to be protected by no leasing and by stipulations that would protect primary calving and migration areas.

(b) Effects from Spills: The potential for an oil spill occurring and contacting areas used by Barrow, Atqasuk, and Nuiqsut subsistence-caribou hunters is very low, considering the data that indicate primarily chronic, small spills that most often are contained on pad. If a spill occurred off the pad, the impact would be very local and would tend to contaminate tundra in the immediate vicinity of the spill source. The number of small, chronic crude-oil and fuel spills is expected to increase under Alternative B, but contamination of ranges for caribou, moose, muskoxen, and other terrestrial mammals would not be significant and losses to any of these populations would be small, with recovery expected within about 1 year (Sec. IV.C.9).

(2) Fish:

(a) Effects from Disturbance: Fish would be subject to disturbance from seismic surveys and the construction of drill pads, roads, airstrips, and pipelines. Fish are likely to be adversely impacted from seismic surveys located over overwintering areas. However, the effects of seismic activities on most fish are expected to be short term and sublethal. Construction impacts would include freshwater withdrawals for ice pads, roads, and airstrips. Adverse effects could occur if water is taken from areas where fish are overwintering. Lethal effects could be expected on 50 to 100 percent of these overwintering fish. Construction of pads, roads, pipelines, and airstrips could cause spawning failure and mortality in 50 to 100 percent of the fish in high-density areas, requiring a 10-year recovery period. In low- density areas a <5-percent spawning failure is expected with an estimated 1-year recovery. Because Alternative B precludes oil and gas leasing in high-density fish habitat, disturbance from seismic and construction are expected to occur in areas of low- to no-fish density, and effects associated with Alternative B are expected to have no measurable effect on arctic fish populations in the planning area. Effects on fish resources from seismic and construction disturbance would increase under this alternative but are expected to be short term, and little measurable impact on the subsistence fisheries of Barrow and Nuiqsut; Atqasuk's subsistence fishery does not quite reach the western edge of the planning area.

Complaints about reduced fish size and harvest size persist in Nuiqsut, although subsistence-fish resources still accounted for 33 percent in 1993 (Pedersen, 1996) and 25 percent in 1995 of the total subsistence harvest for the community (Brower and Opie, 1997) (Sec. IV.C.7).

(b) Effects from Spills: The potential for oil spills occurring and contacting subsistence-fishing areas used by Barrow, Atqasuk, and Nuiqsut subsistence-caribou hunters is very low, considering the data that indicate primarily chronic, small spills that most often are contained on the pad. Oil spills may lethally or sublethally impact fish in the immediate area of a spill, especially in important migration or overwintering areas. However, because of the small size of anticipated spills for this alternative and the fact that leasing would not be allowed in high-density fish habitat, oil spills are expected to lethally or sublethally impact <1 percent of the arctic fish resources in the planning area over the life of the field (Sec. IV.C.7).

(3) Birds:

(a) Effects from Disturbance: Noise disturbance from ground transport in winter and fixed-wing aircraft on personnel flights, camp-supply flights, and aerial surveys is expected to cause substantial impacts on birds. Ground transport in winter is expected to cause ptarmigan, gyrfalcons, and snowy owls to temporarily vacate the area within 100 yards to 0.6 mi of the route. Potential disturbance would occur from aircraft flights supporting base camps, survey camps, wildlife and resource aerial surveys, and point-to-point transport. Molting brant exposed to 10 flights per day are predicted to experience light weight loss, but estimated flight frequency is not expected to average more than 1.1 to 2.4 flights per day. Other molting species are less sensitive than brant to aircraft disturbance. Any nesting and postnesting birds exposed to routine aircraft disturbance could be displaced from local habitats and subject to increased energetic demands. Some consequent effects to reproductive success and survival of young is anticipated, with populations not requiring more than 1 year season to recover.

Potential disturbance from oil and gas exploration and development activities would come from seismic surveys, aircraft and vessel traffic, drilling and construction operations, vehicle traffic, and oil-spill-cleanup activity. Seismic-survey operations temporarily (1-2 days) may displace ptarmigan, gyrfalcons, and snowy owls within several 100 yards to 0.6 mi of survey gridlines. The more tightly spaced 3-D seismic grid may cause these species temporarily (<2 weeks) to vacate areas a few tens of square miles. No significant population effects to these species are expected to occur with effects expected to be minor and temporary. Development air support averaging 1 to 2 flights per day per year is expected to cause variable decreased nesting activity for most species within 100 yards to 0.6 mi of routinely used air corridors. Some localized displacement of nesting birds in the vicinity of drill sites may occur, but significant effects on reproductive success are not expected. Construction disturbance is expected to cause temporary behavioral changes and displacement of winter resident species within 100 yards to 0.6 mi of the site.

Overall disturbance effects to important subsistence species of feeding, molting, and nesting white-fronted geese, black brant, eiders, oldsquaw, and other species are expected to be localized (within 100 yards-0.6 mi of the activity) and temporary (ranging from <1 day for aircraft flight to 3 months for well drilling and ground operations). Recovery in these instances is expected to require no more than 1 year season. Disturbance from more intense activity such as routine flights over goose-molting lakes and increased river traffic would require several breeding seasons for recovery (Sec. IV.C.8).

(b) Effects from Spills: The potential for an oil spill occurring and contacting areas used by Barrow, Atqasuk, and Nuiqsut subsistence-waterfowl hunters is very low, considering the data that indicate primarily chronic, small spills that most often are contained on the pad. Offpad oil spills would put loons and waterfowl at greatest risk. Especially at risk would be the large numbers of molting geese that occupy open waterbodies. Spills entering these larger lakes with larger numbers of molting or broodrearing geese and other species may result in losses in the hundreds, requiring several breeding seasons for recovery. Cleanup activity off the pad is expected to displace small numbers of nesting, broodrearing, and molting birds, with a few clutches or broods lost to predation while adults are absent, with recovery requiring 1 year season. Spills entering lakes with large goose populations would require several breeding seasons for recovery (Sec. IV.C.8).

(4) Bowhead Whales:

(a) Effects from Disturbance: Bowhead whales are not expected to be impacted from seismic surveys, drilling operations, construction activities, or oil spills because all of these activities would occur onshore. Temporary, nonlethal effects to bowheads from aircraft overflights and marine vessel traffic disturbance could occur, but little aircraft activity is expected over water. Also, the northern portion of the planning area would not be leased under Alternative B, thereby eliminating barge-supply traffic to coastal staging areas. Negligible effects from disturbance would be expected by Barrow and Nuiqsut on their subsistence hunt of bowhead whales (Sec. IV.C.10).

(b) Effects from Spills: There would be no leasing in the northern portion of the planning area under Alternative B, thereby eliminating the potential for a fuel-oil spill from a supply barge transporting equipment to coastal staging areas. Small onshore spills are unlikely to reach the marine environment. If spilled oil did reach the marine environment, it likely would be a very small amount and any exposure to spilled oil likely would not pose serious direct effects to bowhead whales (Sec. IV.C.10).

(5) Other Marine Mammals:

(a) Effects from Disturbance: Under Alternative B, local and short-term effects for marine mammals from activities other than oil and gas are expected to be similar to those under Alternative A, with no significant adverse effects to the populations as a whole. The effects of oil and gas activities on marine mammals are expected to increase somewhat over those of Alternative A. However, most oil and gas activities under Alternative B would occur inshore and to the south of the coast. Consequently, only a small increase in noise and disturbance effects is expected along the coast, primarily in the Colville River Delta-inner Harrison Bay area. These effects are expected to be local and short term (generally <1 year) (Sec. IV.C.9).

Nuiqsut whaling captain Thomas Napageak noted in his testimony for Beaufort Sea Sale 144 that because of endangered species regulations, ". . .the taking of polar bears is not very important to us now because we can't do nothing with the hide. The hide, valuable as it is, goes to waste when we kill a polar bear. Because of federal regulations, we cannot sell it" (Sale 144 Public Hearings, Nuiqsut, Nov. 6, 1995).

(b) Effects from Spills: Because of the limited coastal area available for leasing under this alternative and the unlikely scenario of summer barge resupply, it is unlikely that a spill would occur. Small onshore spills are unlikely to reach the marine environment. If spilled oil did reach the marine environment, it likely would be a very small amount and any exposure to spilled oil likely would not pose serious direct effects to marine mammals (Sec. IV.C.9).

c. Effects on Communities: Effects on Barrow, Atqasuk, and Nuiqsut from oil-industry-development disturbance are discussed in detail in Section IV.B.10 of the Beaufort Sea Sale 170 FEIS (USDOI, MMS, In prep.) See previous discussions in this section of effects on the primary subsistence species: caribou (and other terrestrial mammals), fish, birds, bowhead whales, and other marine mammals. Effects assessments from these sections are summarized below; also included is a synthesis of traditional knowledge (where available) that addresses the specific disturbance agents.

(1) Barrow—Effects from Disturbance and Spills: Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow subsistence hunters would have no apparent effect on Barrow's subsistence harvest. Under Alternative B, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative, and from the protection afforded by other management actions (see Effectiveness of Stipulations below).

Barrow resident Charles Brower stated in 1986 that subsistence access could be adversely affected if a pipeline were built; additional hunting restrictions would occur, requiring a permit (Sale 97 Public Hearings, Dec. 8, 1986). And the fact remains that pipelines built in the past have created access problems. Taqulik Hepa, NSB subsistence specialist, has made it clear that an NPR-A IAP/EIS must identify stipulations to protect subsistence-hunting sites, traditional fish camps, and access routes from development impacts (Barrow NPR-A Scoping Meeting, March 17, 1997) (Effectiveness of Stipulations below).

Under this alternative, BLM would determine that the Federal portion of the Colville River to be eligible as a "wild" river in the WSR System. If Congress eventually added the river to the system, BLM would develop a management plan to identify its management practices for the river. One issue that would be addressed in the plan would be whether motorized travel would be allowed on the river. A decision not to allow motorized travel could reduce the use of the river for subsistence.

Oil-industry impacts were described by Barrow elder Jonah Leavitt testifying in court in a class-action suit filed against the U.S. Government in 1980 to gain allotments and protect traditional hunting and fishing areas from industry development within NPR-A: "My grandfather, William J.L. Inuguak, moved on to the land in the fall of 1844. At first he lived in someone else's sod house; then he built his own house. My grandfather lived there because the fishing was so good. Other people would stop at that place and fish when they were on their way to trap foxes up inland. The lake nearby had very good fishing up until 1961. Then a vehicle broke down the side bank of the lake and the water drained out. Now we cannot fish in the lake. Baxter Adams, a resident of Barrow, saw the tracks, and he told me that they were made by an LVT (Land Vehicle Transport) vehicle" (The Arctic Coastal Zone Management Newsletter, Nov. 1980).

Noah Itta described past impacts from older seismic techniques, where fish disappeared for three years due to seismic disturbance. "I'm told that techniques have improved and they don't have to resort to those techniques anymore that have such devastating impacts on fish populations" (Barrow NPR-A Scoping Meeting, March 17, 1997). More recent seismic activity still has considerable effects to wildlife, even when conducted in winter. Harry Brower, Jr., whaling captain and subsistence analyst for the NSB Department of Wildlife Management, had this to say of his recent observations traveling NPR-A:

> I just wanted to mention what some of my personal observations with what's happening with that seismic out there and that seismic displacing the animals. I just wanted to pass this on for your information, and I didn't see any furbearers except for the foxes, the red foxes and the different faces anyway. I didn't see no wolves out there, no tracks or anything like that. I was on my way back home just this Saturday and met up with my cousin and he just said, yeah I just ran into a set of wolverine tracks and followed them 26 miles one direction, and he didn't take a close look at the tracks and he started following the trail and it had just been scared away from where the activity was occurring, which was up on the tops against that southeast side of Teshekpuk up in this Piks dunes out there and he found the den and the rig had just gone by. I just happened to be there when he was following the trail and coming back, he said he just followed the trail 26 miles one direction and the wolverine had just made a bee line from where the seismic activity was going on. It had been scared away from its den. It was just moving out. And there was no caribou in the area. Well you know, I'd seen that. I made these trips up to my cabin. It's up on the Ikpikpuk River and I've observed the displacement of the wildlife over the winter. I've been going back and forth since December to just last week and I've seen the different areas where they've been over the winter, and I just wanted to bring that out, of my personal observations . . . (Barrow NPR-A Scoping Meeting, March 17, 1997).

At the Barrow NPR-A scoping meeting, Johnny Aiken spoke about oil-development impacts on a variety of species:

> We go to Taqulik lake where we go fishing. Every now and then we in that particular lake we hardly get any fish. It's a surprising time. Two years ago we hardly got any grayling from that spot, that's our main grayling fish getter and we hardly got any a couple of years ago; that was surprising. And then in our river Kuparuk, Kuparuk too . . . we hardly get any more fish there . . . and I want to say too that I grew up hunting ugrooks and . . . I don't hardly see those ugrooks out there no more. And those eiders, the colored ones, me and my papa used to hunt them. We don't see those no more, hardly ever see them . . . (Barrow NPR-A Scoping Meeting, March 17, 1997).

Both the establishment of a Subsistence Advisory Panel under this Alternative (and under Alternatives C-E) and the adoption of effective stipulations designed specifically to protect subsistence resources and subsistence practices, will serve to address local concerns about scientific survey impacts to caribou, pipelines as barriers to caribou migration, reduced fish size, fewer fish (grayling) in lakes, pollution impacts from past NPR-A exploration, winter seismic effects to caribou and furbearers, and reduced populations of ugrooks and eiders. The panel was conceived specifically to address local subsistence issues, to assist in monitoring the effects of oil and gas activity on subsistence practices, and to help design solutions to ongoing subsistence conflicts with development.

(2) Atqasuk—Effects from Disturbance and Spills: Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, and marine mammals harvested by Atqasuk subsistence hunters would have no apparent effect on Atqasuk's subsistence harvest. Under Alternative B, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative and from the protection afforded by other management actions (Effectiveness of Stipulations below).

Luke Kagak, president of Atqasuk Search and Rescue, expressed concern for areas critical to calving caribou and nesting waterfowl, suggesting that special management zones be established for these populations. He believes oil development has affected animal migrations and duck populations near Prudhoe Bay. He contends that development should not occur any closer than 15 to 20 mi to these habitats. Kagak adds that the oil industry should be responsible for funding studies that survey these population effects that have already occurred to wildlife near Prudhoe Bay. It is up to industry to prove developments not Native subsistence hunters: "The question is, industry, oil and gas developers in particular, have made life rather difficult for us. We have had to go so far as to make accommodations and pay for scientists . . . to document what we've known so that we can continue a way of life that we've had for centuries or forever. Why not have industry themselves try to find out . . . what happened to those species whose populations we have seen decline over the years because of impacts that they have done?" (Atqasuk NPR-A Public Scoping Meeting, March 18, 1997; Adams, 1997:1, 2). Arnold Brower, Sr., interviewed in the early 1980's, remembers returning from World War II and noticing the extensive environmental damage left by the Navy. He believed that damage done by the Navy near Imagruaq Lake damaged the tundra to such an extent that a drainage ditch was created that lowered the lake's water level and ruined fishing there. After the War, Navy exploration continued and Thomas Brower, Sr., remembers having to negotiate with the Navy so their planes wouldn't buzz his reindeer herd (Arundale and Schneider, 1987).

After World War II, seismic exploration was a problem to the reindeer in other ways, and Brower remembers the seismic wire catching in the hooves of the reindeer and making them lame (Arundale and Schneider, 1987). Fifty years later, seismic activity still is a problem. Karen Burnell, NSB Planning Director, indicated at the March 1997 Atqasuk NPR-A scoping meeting that inspection of seismic crews is necessary to keep their activities in line with permitting guidelines: "We have found a couple of instances where spills had occurred, small spills, but we didn't think they were adequately cleaned up, so we required the company to go back an do a better job. Or there's been debris left behind; we've made them go back and pick it up and since we've started doing that they know that we're going to be following them around; they've changed drastically in the last couple of weeks" (Atqasuk NPR-A Public Scoping Meeting, March 18, 1997).

Access issues are viewed as critical in view of the areas near Prudhoe now off limits to subsistence. Arnold Brower, Jr., NSB NPR-A Coordinator, said that similar firearm restrictions at oil-development sites would create problematic detours for subsistence hunters. Atqasuk subsistence hunter Dave Summond added: "I have an allotment out there at Ikpikpuk. I have land there and it won't be right if I'm not able to take my guns with me for purposes of hunting" (Atqasuk NPR-A Public Scoping Meeting, March 18, 1997).

Past drilling activity in the NPR-A has left its mark. Notes Thomas Brower, Jr.: "I have gone how many times to Inigok where there was some drilling that took place, and I have seen bones from birds that have been killed . . . after they drill a hole, the stuff they leave behind, the fluids. I don't want to see that kind of thing happening where we see our wildlife and waterfowl, dying from contaminants being left after having conducted drilling activity. I don't want to see that kind of thing" (Atqasuk NPR-A Public Scoping Meeting, March 18, 1997).

Considering the overall impact of NPR-A oil development near Atqasuk, Luke Kagak explained: "We need to be thinking of our future and what we leave for our children as we go through this process" (Atqasuk NPR-A Public Scoping Meeting, March 18, 1997). Atqasuk elder Ella Sakeagak, interviewed in the early 1980's, summed up the local attitude (that is still current today) about oil development in the vicinity of the village: "We lived at Suqlak [just west of Teshekpuk Lake]; our little house is up there. It's standing. There's lots of fish, all kinds of animals, and I desperately wish that the people working for oil would not disturb that hunting area" (Arundale and Schneider, 1987).

Both the establishment of a Subsistence Advisory Panel under this Alternative (and under Alternatives C-E) and the adoption of effective stipulations designed specifically to protect subsistence resources and subsistence practices will serve to address Atqasuk's concerns about establishing special game-management zones, impacts to animal migrations, reduced duck populations (especially eiders), the need for industry to monitor development effects to subsistence resources and practices, past environmental damage and contamination from exploration, anticipated contamination from drilling, fuel spills and litter left by seismic crews, firearm restrictions around development sites, and general disturbance to animal populations.

(3) Nuiqsut—Effects from Disturbance and Spills: Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, and marine mammals harvested by Nuiqsut subsistence hunters would have no apparent effect on Nuiqsut's subsistence harvest. Under Alternative B, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative and from the protection afforded by other management actions (Effectiveness of Stipulations below).

Pipelines can create physical barriers to subsistence access, making subsistence hunters' pursuit of caribou more difficult (Kruse et al., 1983). Fourteen years later, this same concern was still being expressed by Nuiqsut officials Leonard Lampe and Thomas Napageak, who recounted how designed caribou crossings of pipelines did not seem to work (Nuiqsut NPR-A Public Scoping Meeting, April 10, 1997).

Elder Pessie Ericklook from Nuiqsut maintained that since the oil fields have been established [at Prudhoe Bay], the fox have been dirty and discolored in [the] area of Oliktok [Point] (Sale BF Public Hearings May 16, 1979). Leonard Lampe, former Nuiqsut Vice Mayor, recently expressed further air-pollution problems and habitat concerns, asserting that Nuiqsut has been experiencing such effects for some time: "A lot of air pollution, asthma, bronchitis—a lot with young children. We see smog pollution that goes from Prudhoe Bay out to the ocean and sometimes to Barrow when the wind is blowing that way. Tundra damage around the village" (Lavrakas, 1996:1, 5). At NPR-A scoping meetings in the village, Lampe reaffirmed his concern for air-quality degradation; Rosemary Ahtuangaruak noted that: "The atmosphere has eroded and the fear of ozone depletion is upon us. What will be done to combat this?" (Nuiqsut NPR-A Public Scoping Meeting, April 10, 1997). A Nuiqsut hunter commented in a subsistence survey done in the community by the NSB Wildlife Management Department in 1995 that white fox couldn't be trapped at Prudhoe Bay anymore because of yellow skin (Brower and Opie, 1997). In this same survey, another hunter observed that gas from Deadhorse was poisoning the animals; he was very concerned about gasses from Prudhoe (Brower and Opie, 1997).

Noting problems with seismic activity, Lampe continued, "I swear they seismiced the entire North Slope. It's dangerous with snowmachines to run into deep seismic trails. There's wire cables all over the place" (Lavrakas, 1996:1, 5). At the Nuiqsut village scoping meeting for NPR-A, Lampe again related village conflicts with seismic activity, explaining that seismic work in the vicinity of the village threatened traditional sites and might have somehow have affected the caribou food chain as well. He suggested that increased traffic on the Dalton Highway might be interfering with migrations by spooking the animals. "Caribou have always been our primary source of subsistence . . . this has got to be evaluated very carefully." (Nuiqsut NPR-A Public Scoping Meeting, April 10, 1997; Adams, 1997:5, 9). At an NPR-A symposium held in Anchorage in April 1997 after the village scoping meeting, Thomas Napageak, elder, Nuiqsut Native Village President, and AEWC Chairman, noted recent problems with seismic activity: "Down by the village two years ago, seismic exploration was moving rapidly right over two graveyards. Of course, the markers were driftwood and had fallen off. But the graveyards were still visible. However, you can't see everything from a Rolligon or exploration vehicle when the snow is drifting. The graveyards were being run over. When I die I would like to rest peacefully under the ground without any seismic activity running over me" (USDOI, MMS, 1997). Ruth Nukapigak recounted that seismic activity has repeatedly trespassed onto her allotment on the Itkillik River and that she has been trying unsuccessfully to get compensation since 1974 (Nuiqsut NPR-A Public Scoping Meeting, April 10, 1997). Oil-exploration crews have been a constant problem to villagers. A cultural plan (*Nuiqsut Paisanitch: A Cultural Plan*) drafted by the village in 1979 noted these objections to field crews by a Nuiqsut resident: "Those oil exploration crews wreck our camps. They tore up our ice cellars at Oliktok and left meat and fish around to rot. They must not know we use those camps" (City of Nuiqsut, 1995).

Nuiqsut fish harvesters have noted that the number of arctic cisco have been down, coinciding with the [operation of] the Endicott water-treatment plant (Northstar Project Community Meeting, Aug.13-15, 1996). A Nuiqsut subsistence fisherman wondered in a subsistence survey done in the community by the NSB Wildlife Management Department in 1995 why whitefish were so small that year when they used to be big last year (Brower and Opie, 1997). At the April 1997 NPR-A scoping meeting in Nuiqsut, Rosemary Ahtuangaruak elaborated on development impacts to fish and the associated impact to village life: "The oil companies made causeways for the benefit of oil development. It took the fish away. The people suffered immensely without this natural resource. The community could not meet the needs for survival and the atmosphere was black. We had an increase in all the bad things: domestic violence, suicide, family demise" (Nuiqsut NPR-A Public Scoping Meeting, April 10, 1997).

In 1979, Nannie Woods, the late Nuiqsut elder, talked about fish and caribou being abundant at the Sagavanirktok River, but now the river isn't as abundant since the development at Prudhoe Bay. She explained that the tributaries off the river don't have as many fish either, and that there are fewer caribou than there used to be in the summer (Sale BF public hearings, May 16, 1979).

Concerns about access restrictions have been voiced by local residents. Sarah Kunaknana, talking about local subsistence hunters, observed that others have stated that they don't hunt near Prudhoe Bay anymore because of oil development (S. Kunaknana, in Shapiro, Metzner, and Toovak, 1979). Nuiqsut's present Vice Mayor Mark Ahmakak, when asked in 1982 if people had been turned back from hunting and fishing areas, answered: "Oh, yes. I have experienced that myself in going out towards Nuiktak [?] over toward DEW Line station. We have been told by oil company officials that we can't hunt near development area" (Kruse et al., 1983). Access problems were expressed by Nelson Ahvakana from Nuiqsut. He was concerned that areas that are supposed to be left open for subsistence hunting effectively will be closed because of increased security associated with the new drill sites, and that access to subsistence resources will be restricted (Sale 124 Public Hearings, Apr. 19, 1990). This concern takes on even more substance as the Northstar Project and development at the Alpine field become realities. During the 1996 Northstar Project Nuiqsut community meeting, two Nuiqsut men described being denied access to fishing and hunting areas around Prudhoe operations, even though they have traditional rights to be there. They do not want to be restricted or denied access by new projects (Northstar Project Community Meeting, Aug.1-2, 1996). In recent NPR-A scoping meetings in the village, Thomas Napageak elaborated on the issue of lost access noting that oil development at Prudhoe Bay and Kuparuk had already cut off Nuiqsut residents from nearly one-third of their traditional subsistence harvest areas. At the same meeting, Leonard Lampe, Jr., recounted how he has not been able to hunt or fish in the Kuparuk/Prudhoe Bay area once visited by village elders and that he fears the same loss of critical subsistence access to important lands in the NPR-A to future generations (Nuiqsut NPR-A Public Scoping Meeting, April 10, 1997).

A major issue with the recent initiative in the NPR-A is the velocity of the environmental assessment process and the way it has taxed the resources of the Native community. Nuiqsut residents believe it precludes a thorough compilation of the vast cultural knowledge the Inupiat have gained over millennia. Leonard Lampe, Jr., Kuukpik Village Corporation officer, commented that 11,000 years of cultural and traditional knowledge could not be compiled and communicated in 8 days (Nuiqsut NPR-A Public Scoping Meeting, April 10, 1997; Adams, 1997:5, 9). At the same meeting, Rosemary Ahtuangaruak vocalized this problem more simply when she said: "What we have to say will be documented but not integrated. We are being pushed and pulled in all directions at the same time with all the various agencies affecting our ability to thoroughly evaluate and document all issues." Taqulik Hepa, Barrow subsistence analyst, did not believe the schedule set by BLM would allow for sufficient time for the proper analysis of recent wildlife and subsistence harvest data (Nuiqsut NPR-A Public Scoping Meeting, April 10, 1997).

Oil spills also are an identified threat. Thomas Napageak stated in his testimony at the Nuiqsut NPR-A scoping meeting that: "The oil industry still does not have adequate technology for oil spill clean up in the Arctic, particularly in rivers, lakes, and the Beaufort Sea. Adequate spill response must be part of any development" (Nuiqsut NPR-A Public Scoping Meeting, April 10, 1997).

Thomas Napageak expresses the larger issue of oil development and its potential effect on the subsistence lifeway: ". . . improvements in our physical comforts and services should not blind us to the threats that oil development on the wrong terms poses to our very identity and culture. Our land and our subsistence practices are our history, our identity, and our future. If we lose the land or can no longer maintain our subsistence culture, we lose ourselves and the future of our children." Rosemary Ahtuangaruak further elaborated Inupiat cultural conflicts with oil development when she asserted: "We need to live as our ancestors have shown us. We have this passion to our families for their survival . . . NPR-A has been set aside and should be left alone. It has given the sustenance for countless animals that migrate throughout the world. They come back to us every year unless development prevents it" (Nuiqsut NPR-A Public Scoping Meeting, April 10, 1997).

Both the establishment of a Subsistence Advisory Panel under this Alternative (and under Alternatives C-E) and the adoption of effective stipulations designed specifically to protect subsistence resources and subsistence practices will serve to address Nuiqsut's concerns about (a) pipelines as barriers to caribou migration, (b) ineffective caribou crossings in existing pipelines, (c) air pollution from Prudhoe Bay, (d) discoloration in white foxes, (e) tundra damage near the village, (f) air-quality degradation from Prudhoe Bay development, (g) gasses from Prudhoe Bay poisoning wildlife, (h) the dangers of seismic trails to hunters on snowmachines, (i) seismic impacts on the caribou food chain, (j) damage to traditional sites and allotments from seismic activity, (k) difficulty receiving any compensation for seismic damage to traditional sites, (l) road-traffic interference with caribou migrations, (m) fewer arctic cisco and smaller whitefish, (n) causeway impacts to fish, (o) reduced fish and caribou abundance in the Sagavanirktok River and its tributaries, (p) fewer caribou in summer, (q) access restrictions on subsistence hunters and loss of harvest areas from general development and specifically from increased security around encroaching drill sites, (r) inadequate technology for cleaning up spills in lakes and rivers, (s) the fast-track schedule for the NPR-A IAP/EIS will prevent proper analysis of wildlife and subsistence data, (t) what we (Nuiqsut residents) say will not be integrated, and (u) overall development threats to Inupiat cultural identity.

(4) Other Communities—Effects from Disturbance and Spills: Other communities within or adjacent to the NPR-A are the Chukchi Sea villages of Point Lay and Wainwright to the west and the inland community of Anaktuvuk Pass to the south and east. Subsistence-harvest areas for these communities are not within or adjacent to the planning area, although recent research indicates that movement by the Teshekpuk Lake Caribou Herd does bring the herd into the traditional subsistence-harvest areas of the communities of Wainwright and Point Lay. Historically, Anaktuvuk Pass caribou hunters have ranged to the southerly boundary of the planning area, and movement by the Teshekpuk Lake Caribou Herd would bring it into the harvest area of Anaktuvuk Pass subsistence hunters as well, although they primarily hunt the Western Arctic Caribou Herd (and to a lesser extent the Central Arctic Herd). Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake and Central Arctic herds would have no apparent effect on the subsistence-caribou harvest of these three communities.

Summary: Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters would have no apparent effect on subsistence harvests in these communities. Under Alternative B, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative and from the protection afforded by other management actions (Effectiveness of Stipulations below).

Conclusion—First Sale: Overall effects associated with Alternative B subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to periodically impact subsistence resources, but no resource would become unavailable, undesirable for use, or experience overall population reductions.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative B increases from a range of 65 to 350 MMbbl and zero to one oilfields to a range of 90 to 500 MMbbl in zero to two oilfields. The number of exploration wells increases from a maximum of 4 to 14, delineation wells increase from a maximum of 6 to 12, and production wells increase from 83 to 150. Pipeline miles increase to 90 mi. Multiple sales would occur over a longer period of time and, depending on the frequency of sales, the timeframe for oil and gas activities in the planning area would extend to at least two decades.

For Alternative B, it is estimated that the number of spills <1 bbl would increase from a range of 0 to 53 spills to a range of 0 to 75 spills, and the number of spills >1 bbl would increase from a range of 0 to 17 spills to a range of 0 to 25 spills over the assumed production life of the planning area. The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 0 to 70 spills to a range of 0 to 100 spills (Sec.IV.A.2).

If several lease sales occur under Alternative B, considerably more exploration activity is expected to occur in the southern half of the planning area, and the levels of effects due to noise, disturbence, and habitat alteration is expected to increase. Surface, air, and foot traffic near oilfield facilities is expected to increase and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year. For arctic fish populations, each additional lease sale is expected to have similar effects on arctic fish as described for Alternative B. However, if there are increased levels of activity associated with future lease sales, and/or insufficient recovery time between sales, greater adverse effects than described for Alternative B are likely to occur. An increase in effects to bird populations from increased noise disturbance could be expected with multiple sales. Any nesting and postnesting birds exposed to routine aircraft disturbance could be displaced from local habitats and subject to increased energetic demands. Some consequent effects to reproductive success and survival of young is anticipated with populations not requiring >1 year to recover. Some localized displacement of nesting birds in the vicinity of drill sites may occur, but significant effects on reproductive success are not expected. Construction disturbance is expected to cause temporary behavioral changes and displacement of winter resident species within 100 yards to 0.6 mi of the sites. Recovery in these instances is expected to require no more than 1 year. Disturbance from more intense activity such as routine flights over goose molting lakes and increased river traffic would require several breeding seasons for recovery. Offpad oil spills would put loons and waterfowl at greatest risk. Especially at risk would be the large numbers of molting geese that occupy open waterbodies. Spills entering these larger lakes with larger numbers of molting or broodrearing geese and other species may result in losses in the hundreds, requiring several breeding seasons for recovery. Effects of multiple sales on bowhead whales are expected to be essentially the same as described for the first sale. Bowhead whales exposed to noise-producing activities such as marine vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Small onshore spills are unlikely to reach the marine environment. If spilled oil did reach the marine environment, it likely would be a very small amount, and any exposure to spilled oil likely would not pose serious direct effects to bowhead whales. For marine mammals, multiple sales under Alternative B are expected to have similar effects to those under Alternative B with one sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Conclusion—Multiple Sales: Effects from multiple sale to terrestrial mammals are expected to increase, but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude-oil and fuel spills, but populations are expected to recover within 1 year. Arctic fish populations would experience effects similar to Alternative B as high-density fish areas are deferred, but increases are expected if sale intervals are not spaced sufficiently to provide population recovery. Increased disturbance and displacement effects and increased oil-spills risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. Bowhead whales are expected to experience short-term, nonlethal effects. Effects to marine mammals would be short term and local with no adverse effects to populations.

Given that resource estimates and development scenarios project an increase in resources and large increases in the number of drill pads and pipeline miles, logic would assume increased effects to potentially affected resources, except for the fact that these effects would be spread over 2 decades. The biological analyses expect slight increases in effects with little overall effects to resource populations; therefore, effects associated with multiple sales on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and (especially) Nuiqsut as a result of impacts from disturbance and oil spills are expected to make no subsistence resource unavailable, undesirable for use, or experience overall population reductions.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.C.7, Fish Resources, IV.C.8, Birds, IV.C.9, Mammals, and IV.C.10, Endangered and Threatened Species. Important proposed subsistence stipulations that would specifically protect subsistence practices include a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on the NPR-A. Additionally, important proposed subsistence stipulations would require lessees:

1. To monitor exploration, development, and production effects on subsistence.
2. To not unreasonably restrict subsistence access by establishing procedures for use and firearm discharge near oil facilities.
3. To notify BLM if conflicts arise between the lessee and subsistence hunters and that BLM resolve the issue.
4. To consult with local communities about siting, timing, methods of operation, and possible mitigation to assure that exploration, development, and production activities are compatible with subsistence practices to encourage conflict resolution. Local communities, the NSB, and the Subsistence Advisory Panel all will concurrently review any exploration, development and production plans, and any interested party may request that BLM resolve disputes that cannot be otherwise settled.
5. To provide an employee-orientation program that addresses environmental, social, and cultural concerns relating to the NPR-A.
6. To conduct an inventory of known traditional land use sites to develop a plan to avoid these sites and to mitigate any possible damage to them.

14. Sociocultural Systems: This discussion is concerned with those communities that could be impacted by ground-impacting-management actions and oil and gas leasing in the planning area. These communities are Barrow, Atqasuk, and Nuiqsut. Under Alternative B, a maximum protection to surface resources would be emphasized by making unavailable to oil and gas leasing 2.61 million acres (2.04 million would remain available). The Teshekpuk Lake Watershed, Goose Molting Habitat, Spectacled Eider Nesting Concentrations, Teshekpuk Lake Caribou Habitat, and Fish Habitat LUEA's would be unavailable to oil and gas leasing. Leasing would be deferred on lands subject to pending Kuukpik Corporation conveyances. The Colville River would be recommended to be included in the Wild and Scenic River System and managed as such. The BLM's option to regulated motorized use of and access to the river could disrupt subsistence-hunters' use of the upper Colville and local opinion in Barrow and Nuiqsut clearly opposes such a designation.

Raptor, passerine, and moose areas on the Colville River, the Pik Dunes, Ikpikpuk Paleontological Sites, and recreation and scenic areas also would be made unavailable to oil and gas leasing and subject to restrictions for siting pipelines and industrial structures.

The primary aspects of the sociocultural systems covered in this analysis are (1) social organization, (2) social health, and (3) cultural values, as described in Section III.C.3. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level, predominantly by industrial activities, increased population, increased employment, and effects on subsistence-harvest patterns associated with a proposed oil and gas lease sale. Potential effects are evaluated relative to the tendency of introduced social forces to support or disrupt existing systems of organization and relative to how rapidly they occur and their duration (Langdon, 1996).

North Slope Inupiat continue to express concern about the differences in how they and the dominant culture relate to the land and waters. Rex Okakok from Barrow expressed the problem when he said "Our land and sea are still considered and thought by outsiders to be the source of wealth, a military arena, a scientific laboratory, or a source of wilderness to be preserved, rather than as a homeland of our Inupiat" (Sale 109 Public Hearings, Apr. 10, 1987). Considering such use of Inupiat territory, Robert Edwardson from Barrow said that he would like to see revenues paid to the Inupiat for mineral rights (Sale 144 Public Hearings, Nov. 8, 1995; see Sec. IV.C. 13., Subsistence).

a. Parameters of this Analysis: An analysis of the social organization of a society involves examining how people are divided into social groups and networks. Activities such as the sharing of subsistence foods are profoundly important to the maintenance of family ties, kinship networks, and a sense of community well-being. In rural Alaskan Native communities, task groups associated with subsistence harvests are important in defining social roles and kinship relations: the individuals one cooperates with help define kin ties, and the distribution of specific tasks reflects and reinforces the roles of husbands, wives, grandparents, children, friends, and others (Sec. III.C.3). Social groups generally are based on kinship and marriage systems, as well as on nonbiological alliance groups formed by such characteristics as age, sex, ethnicity, community, and trade. Kinship relations and nonbiological alliances serve to extend and ensure cooperation within the society.

An analysis of cultural values looks at those values shared by most members of a social group. Generally, these values are shared conceptions concerning what is desirable. They are ideals that members of a social group accept explicitly or implicitly. Forces powerful enough to change the basic values of an entire society would include a seriously disturbing change in the physical conditions of life. a fundamental cultural change imposed or induced by external forces, such as when an incoming group induces acculturation of the residing group, or when a series of fundamental technological inventions change existing physical and social conditions. Such changes in cultural values can occur slowly and imperceptibly or suddenly and dramatically (Lantis, 1959). For the system of sharing to operate properly, some households must be able to produce, rather consistently, a surplus of subsistence goods, and it is obviously more difficult for a household to produce a surplus than to simply satisfy its own needs. For this reason, sharing, and the supply of subsistence foods in the sharing network, could be more sensitive to harvest disruptions than the actual harvest and consumption of these foods by active producers.

Social organization could be affected by an influx of new population that causes growth in the community and/or change in the organization of social groups and networks. Disruption of subsistence-harvest task groups would damage the social bonds that hold the community together. Disruption of the subsistence cycle also could change the way these groups are organized. A serious disruption of subsistence-harvest patterns could alter these cultural values and could trigger an array of negative emotions: fear, anger, and frustration, as well as a sense of loss and helplessness. Because of the psychological importance of subsistence in these sharing networks, perceived threats to subsistence activities are a major cause for anxieties about oil development.

An Alaska Department of Fish and Game social-effects survey administered by the Division of Subsistence in 1994 in Nuiqsut included questions on effects from Outer Continental Shelf development. The majority of Nuiqsut residents believed that development would negatively impact fish, marine mammal, and bird resources. Most were not in favor of further oil development because of its perceived adverse impact on subsistence and the belief that small and large oil spills could not be effectively contained or cleaned up. The overall study on 21 Alaskan communities concluded that impacts persist from the *Exxon Valdez* Oil Spill on subsistence use and the social and cultural system that subsistence activities support (Fall and Utermohle, 1995).

A study conducted by Picou et al. (1992) on the disruption to the community of Cordova by the *Exxon Valdez* Oil Spill demonstrated empirically that 18 months following the spill, residents of Cordova had experienced long-term negative social impacts that took the form of disruption to work roles and increased personal stress. Additionally, they observed that ". . .work disruption was correlated with intrusive stress. . .and fishermen experienced more work disruption than. . .other occupations. It may be possible that other natural resource community activities such as participation in subsistence harvests. . .may identify subpopulations more vulnerable to long-term negative social impacts" (Picou et al., 1992).

In the Social Indicators Study of Alaskan Coastal Villages, Volume VI. Analysis of the *Exxon Valdez* Spill Area, 1988-1992, the summary of findings section affirmed that immediately after the spill and continuing into early 1990, Natives decreased their harvests of wild resources and relied on preserved foods harvested before the spill. By the winter of 1991, Native harvesting activities had began to resume to normal, but the proportions of wild foods in their diets remained below 1989 proportions. The study also demonstrated in its analysis that non-Natives and Natives "define the environment and resources within the environment very differently. Commodity valuation takes precedence" for non-Natives and "instrumental use and cultural and spiritual valuation take precedence" for Natives (Human Relations area Files, Inc., 1994). The ADF&G and Picou et al. surveys and the Social Indicators Study demonstrate the impacts to social and cultural institutions and indicate the underlying fears that linger from such a catastrophic environmental event, even in communities not directly impacted by such an event.

Effects Agents: The agents associated with management actions and oil and gas leasing in the planning area that could affect the sociocultural institutions and systems in communities in the sale area (described in Sec. III.C.3) are disturbance and oil spills (and cleanup) from activities other than oil and gas exploration, and oil and gas exploration and development activities that would include changes in population and employment, and effects on subsistence-harvest patterns.

b. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for sociocultural systems under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Exploration activities—seismic activity and exploration drilling—would occur in winter (early December to mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Under Alternative B, one field with a resource range of 65 to 350 MMbbl of oil is estimated. Four exploration wells would be drilled. For development, 6 delineation and 83 production and service wells would be drilled, as well as 75 mi of pipeline constructed.

(a) Effects of Disturbance: During the exploration phase, facilities at Kuparuk and Prudhoe/Deadhorse would be used for air-support staging where personnel and air freight would be transferred to aircraft. Two fixed-wing aircraft trips per week per drill unit are assumed for exploration. The existing facilities at Kuparuk and Prudhoe Bay are adequate to handle the projected needs during exploration. With the use and upgrading of existing infrastructure for the staging of air support, contact with non-Native construction personnel in the villages of Atqasuk and Nuiqsut would not be expected to occur except under exceptional circumstances. Air traffic through Barrow might increase, but no significant staging of equipment or personnel would occur from the community. During the development phase, facilities at Kuparuk and Prudhoe Deadhorse also would be used for air-support staging, and air traffic would increase.

(b) Spills and Spill Cleanup: See Section IV.C.13, Subsistence for a discussion of North Slope onshore spills.

All planning-area scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would substantially affect the subsistence harvest (Sec. IV.C.13, Subsistence).

Other industrial activities associated with oil development that could have an effect on sociocultural systems would be the result of cleanup if an oil spill did occur. In the event of a large spill contacting and extensively oiling habitats, the presence of hundreds of humans, boats, and aircraft would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters (Sec IV.C.3, Water Quality). Because oil spills estimated from NPR-A activities would be small, chronic events and normally be contained on the drill pad, effects from the spills themselves and potential disruption from cleanup activities are not likely to cause great disturbance to sociocultural systems or the surrounding environment, and impacts would be negligible.

Nuiqsut residents reiterated at a recent town meeting for the Northstar Project that they believe it is a matter of when a spill will occur, not if it will occur. They want assurance against disaster and impact funds set aside for them in the event of such a disaster (Nortinstar Project Community Meeting, Aug. 13-15, 1996). Earlier village comments expressed the same attitude. In 1979, Gordon Rankin from Kaktovik suggested that a compensation fund be set aside for villages in case there is a devastating oil spill (Sale BF Public Hearings, May 15, 1979; see Sec. IV.C.13, Subsistence).

c. Population and Employment: Under Alternative B, oil and gas leasing in the planning area is projected to affect the population of the NSB through two types of effects on regional employment: (1) more petroleum-industry-related jobs as a consequence of NPR-A exploration and development and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (see Sec. IV.B.11). Employment projections as a consequence of planning-area activities are provided in Section IV.C.11. With this alternative, total petroleum-related employment would range from a low of 93 jobs (exploration only) in the year 2000 to 1,500 jobs (with development) in 2006. Resident employment as a result of NPR-A activities would peak at 44 jobs in the year 2006. Most workers are expected to permanently reside outside of the North Slope. The NPR-A oil and gas activities are projected to increase resident employment 3 percent during the development phase and 2 percent during the production phase above the declining existing-condition projections between 2000 and 2016 (Tables IV.D.11-1 and IV.D.11-2).

The NPR-A development under Alternative B is projected to increase the NSB population above the existing-condition level if oil prices are high enough to allow for maximum development (1,100 MMbbl). The Native proportion of the population is not expected to change much—approximately 70 to 77 percent Native. There may be some degree of sale-induced employment, but these changes, particularly as they translate into Native employment, historically have been and are expected to continue to be only 1 percent of total oil-industry jobs in the region. Even though Native employment in oil-related jobs on the North Slope is low, Native leaders continue to push for programs and processes with industry that would encourage more Native hire.

d. Subsistence-Harvest Patterns: Subsistence is important to the Inupiat sociocultural system through sharing subsistence foods, creating community task groups and crew structures, and through the strengthening of social bonds (see Sec. III.C.3 for a detailed description). Effects could be expected on subsistence-harvest patterns in the planning area as a result of disturbance to Barrow, Atqasuk, and Nuiqsut's subsistence harvests due to seismic disturbance, aircraft noise, supply vessel traffic, onshore-construction, and oil spills (see discussion for Alternative B, Sec. IV.C.13).

e. Effects on Barrow, Atqasuk, and Nuiqsut: The relatively homogenous nature of the communities of Atqasuk and Nuiqsut—both are predominantly Inupiat—whose sociocultural systems may be affected by oil and gas activities in the planning area indicates that changes in the communities would be similar. Barrow, which is larger, has a larger percentage of non-Natives and already has experienced more change than the other two smaller Native communities. This section analyzes effects of industrial activities, population and employment changes, and subsistence-harvest-pattern impacts on North Slope social organization, cultural values, and other issues. This discussion focuses on the North Slope as a whole, with a discussion of each community where necessary.

(1) Social Organization: The social organization of communities that might be affected by oil and gas activities in the planning area includes typical features of Inupiat culture: kinship networks that organize much of a community's subsistence-harvest, consumption, and sharing activities; informally derived systems of respect and authority; strong extended families (although not always living in the same household); stratification between families focused on success in the subsistence harvest; and access to subsistence technology (Sec. III.C.2). These non-Western elements of social organization could be altered to become less oriented toward the family, and changes would be exhibited in a breakdown of kinship networks as a result of social conditions induced by oil and gas activities in the planning area. Increased air traffic and winter ice-road traffic during exploration is unlikely to have a large effect on these communities, except possibly increases in noise disturbance to the community of Nuiqsut. Any increase in non-Natives in the community would be considerably less than the number of non-Native workers present in North Slope communities during the peak of the Capital Improvements Program construction years in the 1980's. Other industrial activities (pipeline construction) would occur nearest to the community of Nuiqsut but not within the actual community itself. Changes in population and employment would not be greater than those already experienced in the past by these communities. Social institutions in all three communities would experience little direct disturbance from the staging of personnel and air freight expected for oil and gas activities in the planning area for exploration, development, and production.

negligible effects would be expected to sociocultural systems, and no displacement of existing institutions would occur. The scenario for oil and gas activities in the planning area stresses that staging will occur primarily from existing or enhanced facilities at the Prudhoe Bay/Deadhorse and Kuparuk, a situation that significantly would reduce disruption to nearby Native communities.

No disruptions are expected to the three communities' social institutions as a result of increases in temporary or permanent population growth, but the construction of winter ice roads near Nuiqsut could cause some disruptions to Nuiqsut social organization because of an increase of social interaction between residents and oil-industry workers. Traffic restrictions near exploration infrastructure along the Nuiqsut/Prudhoe Bay ice road already has created some friction in Nuiqsut, where considerable dependence has developed on this arterial for winter access to Prudhoe Bay and south to Fairbanks. Locally, Nuiqsut residents have articulated these conflicts, as seismic and drilling activity has increased dramatically for offshore projects such as the Northstar development and seismic and drilling activities from the onshore Alpine field and potential NPR-A development.

Other instances of increased interaction would occur if local residents were employed in oil-industry jobs but, historically, the number of local Native hires is quite small. Some of the interactions of oil workers with the local Inupiat population are likely to be unpleasant and could lead to a growth in racial tension. Nuiqsut already has been exposed to oil workers due to its proximity to Prudhoe Bay, village travel to Prudhoe on the winter ice road that is maintained between the two communities, and increased seismic activity in the vicinity of the village. But it is not likely that the number of oil workers associating with local residents would increase much above the number that is already occurring. Social interaction of oil-industry workers with Nuiqsut residents could be long term, but there would not be a tendency toward displacement of their social institutions. Changes in population and employment are unlikely to cause disruption to sociocultural systems and would not displace existing institutions.

Subsistence is a cyclical activity, and harvests vary from year to year, sometimes substantially. Numerous species are hunted to compensate for a reduced harvest of a particular resource in any one year, but there is no satisfactory replacement for bowhead whales or caribou. Multiyear disruptions to even one resource, particularly one as important as the caribou or the bowhead whale, could disrupt sharing networks and subsistence-task groups. Other tensions perceived as a threat to subsistence resources could be caused by NPR-A oil and gas activities, especially if oil-industry activities are visibly evident, and North Slope residents in the Northeast planning area do not perceive development as a benefit to the Inupiat people.

Speaking at a 1983 hearing for an MMS sand and gravel lease sale, Nuiqsut resident Mark Ahmakak stated: "I think that if you are going to go ahead with this sale that you should utilize Natives in. . .the areas affected by this lease sale; then utilize some of these Natives as monitors on some of your projects" (Arctic Sand and Gravel Public Teleconference, Anchorage, Jan. 4, 1983). The general consensus is the desire for some benefit or employment opportunity to the community from nearby oil activities. Nuiqsut resident Joseph Ericklook expressed the community desire to see employment opportunities for local people result from development (Sale 124 Public hearings, Apr. 19, 1990). Arnold Brower, Jr. noted that he would like to see residual rights to old abandoned wells in the NPR-A pass to the local communities because the local communities could benefit from local oil and gas resource development even when they were not economic for industry to develop (NPR-A Atqasuk Public Scoping Meeting, Mar. 18, 1997; Sec. IV.C. 13., Subsistence).

(2) Cultural Values: Cultural values and orientations (as described in Sec. III.C.2) can be affected by changes in the population, social organization and demographic conditions, economy, and alterations of the subsistence cycle. Of these, the only changes that could be expected to occur would be in Nuiqsut's social organization (see discussion above) and the subsistence cycle in Barrow, Atqasuk and Nuiqsut (see Sec. IV.C.14 and discussion above).

A trend toward displacement of the community social institutions could lead to a short-term decreased emphasis on the importance of the family, cooperation, sharing, and subsistence as a livelihood. Increasing oil-development activity could increase access to urban communities and cause more interaction with oil-industry workers, resulting in the introduction of new values and ideas as well as increased racial tensions and an increased availability of drugs and alcohol. Tensions would be created and could result in increased incidents of socially maladaptive behavior and family stress, potentially straining traditional Inupiat institutions' abilities to maintain social stability and cultural continuity. Cultural values and orientations can change slowly or suddenly (Lantis, 195[illegible]).

Long-term change depends on the relative weakening of traditional stabilizing institutions through prolonged stress and disruptive effects that could be exacerbated by activities accompanying the IAP. These changes already are occurring to some degree on the North Slope as a result of onshore oil and gas development, more dependence on a wage economy, higher levels of education, improved technology, improved housing and community facilities, improved infrastructures, increased presence of non-Natives, increased travel outside of the North Slope, and the introduction of television and the Internet. To mitigate this onslaught, NSB institutions, such as the school district that promotes teaching Inupiat language and culture, the AEWC that negotiates with industry to protect Inupiat subsistence whaling interests, the Borough's Department of Wildlife Management, and other regional and village Native corporations and organizations, all work vigorously and quite successfully at preventing any weakening of traditional cultural institutions and practices.

Subsistence is considered the core value and central feature of Inupiat cultural values (see Sec. III.C.2). While a year-long disruption to only one subsistence resource likely would not cause long-term, chronic disruption or displacement of the sociocultural system, multiyear disruptions throughout the 35-year life of the project could begin affecting cultural values, with the potential for long-term sociocultural change and the displacement of existing institutions. When a group's identity is formed around being able to hunt, particularly caribou and bowhead whales, and this hunt is not possible or not successful due to oil-industry activity, a considerable amount of social stress, tension, and anxiety are likely to occur (see the *Exxon Valdez* Oil Spill discussion above).

Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake and Central Arctic caribou herds, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters would have no apparent effect on subsistence harvests. No leasing in important caribou, waterfowl, and fishing areas under this alternative and protection afforded by other management actions (see Effectiveness of Stipulations below) would further minimize impacts.

Overall effects associated with Alternative B subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative A, but subsistence resources would be impacted only periodically with no apparent effect on subsistence harvests. Short-term disruptions of subsistence-harvest activities would cause periodic disruption to institutions and sociocultural systems but likely would not displace existing institutions.

Native testimony at hearings for North Slope development actions has presented ways to mitigate such impacts. At MMS hearings in 1982, Mark Ahmakak from Nuiqsut stated that there should be economic benefits to Nuiqsut, such as cheaper diesel (Sale 71 Public Hearings, Feb. 3, 1982). Barrow resident Charles Okakok said that subsistence users should be compensated by the oil industry in case of an oil spill (Sale 144 Public Hearings, Nov. 8, 1995). This sentiment has been repeated often by Native resident of the North Slope. There are concerns about protecting traditional sites from development. Nannie Woods expressed her opposition to leasing in the Colville River Delta because of her concern for her husband's burial site that might be disturbed by development (Sale 71 Public Hearings, Feb. 3, 1982). Recently, a Nuiqsut elder had her "home place" at Prudhoe Bay desecrated by an oil company. Her house was looted and built over. She emphasized that graves of family members are in the area, and that she has been denied access there (Northstar Project Community Meeting, Mar. 27, 1996). Susie Akootchook, Village Coordinator for Kaktovik, commented during MMS scoping meetings for Sale 170 in Nov. 1996, that traditional fishing and hunting sites need protection, and that a contingency plan needs to be developed to protect them (Sale 170 Kaktovik Scoping Meetings, November 12, 1996). The need for impact assistance often is articulated at hearings held in local communities (USDOI, MMS, 1997).

(3) Social Health: Effects on sociocultural systems often are evidenced in rising rates of mental illness, substance abuse, and violence. This has proven true for Alaskan Natives who have been faced since the 1950's with increasing acculturative pressures. The rates of these occurrences far exceed those of other American populations such as Alaskan non-Natives, American Natives, and other American minority groups. For the period 1980 through 1989, the rate for Alaskan Native deaths from suicides and homicides was 77.9 per 100,000 compared to the rate of 25.8 per 100,000 for non-Natives; half of the Alaskan Native suicides are committed by 15- to 24-year olds. The alcohol mortality rate for Alaskan Natives is three- and- one-half times higher than the rate for non-Natives (4.1/10,000 for Natives; 1.2/10,000 for non-Natives). The reports of harm from physical abuse, neglect, and sexual abuse translate into a rate of 94 alleged victims per 1,000 Native children as compared to 55 per 1,000 children in non-Native communities. Although the Native population of Alaska represents 16 percent of the total Alaskan population, a 1991 study reported that for persons under the age of 18 arrested in Alaska, of those arrested for rape, 50 percent were Native; for aggravated assault, 30.7 percent were Native; for burglary, 37.1 percent were Native; for arson, 37.5 percent were Native; and for alcohol-related offenses, 39.8 percent were Native (Alaska Natives Commission, 1994; Middaugh et al., 1991; Kraus and Buffler, 1979). Also, rates of mental illness are higher ". . .in larger rural Native towns than in the more traditional Native villages" (Foulks and Katz, 1973; Kraus and Buffler, 1979). While such behaviors are individual acts, the rates at which they occur vary among different groups and through time. These changing rates are recognized as the results of a complex interaction of interpersonal, social, and cultural factors (Kraus and Buffler, 1979; see also Kiev, 1964; Murphy, 1965; Inkeles, 1973). Traditional Native communities help buffer the individual by providing a sense of continuity and control.

Increases in social problems—rising rates of alcoholism, drug and alcohol abuse, domestic violence, wife and child abuse, rape, homicide, and suicide—also are issues of direct concern in this analysis of sociocultural systems (see Sec. III.C.3). Local Prince William Sound residents participating in the cleanup of the *Exxon Valdez* Oil Spill in Prince William Sound in 1989 tended to: (1) not participate in subsistence activities, (2) have a surplus of cash to spend on material goods as well as drugs and alcohol, and (3) not seek or continue employment in other jobs in the community (because oil-spill-cleanup wages typically were higher than those earned in the community). Studies indicate that the sudden, dramatic increase in income as a result of working on the oil-spill cleanup, as well as being unable or unwilling to pursue subsistence harvests because of the spill, caused considerable social dislocation—particularly seen in increases in depression, violence, and substance abuse (Fall and Utermohle, 1995; Cohen, 1993; Picou and Gill, 1993; Picou et al., 1992; Fall, 1992; Impact Assessment, Inc., 1990e).

Although the oil industry strictly forbids the consumption of alcohol and drugs by camp workers, such events frequently occur in Prudhoe Bay and Kuparuk. In Prudhoe Bay, it is often the service industries that have not complied with enforcing the ban on alcohol. The increased availability of drugs and alcohol in local communities as a result of increased traffic through their airports, visitors in town, and oil-industry workers associating with local residents could be disruptive to the social well-being of these communities. These problems already have occurred in Nuiqsut, which is within 35 mi of Kuparuk and 65 mi of Prudhoe Bay. Although not accessible by road year-round, Nuiqsut is connected to the Prudhoe Bay/Kuparuk industrial complex by a winter road and by air. An increase in social problems (consumption of alcohol and drugs, sexual abuse, domestic violence) in Nuiqsut at a rate slightly higher than in other North Slope communities has been observed possibly because of Nuiqsut's road accessibility (Armstrong, 1985).

Although there may be additional reasons for differences in social problems in local communities, it is clear that accessibility to cities and larger communities enables residents easier access to drugs and alcohol, thereby affecting the social health of the community—a situation that could intensify in Nuiqsut as a result of NPR-A oil and gas activity. Any effects on social health would have ramifications in the social organization, but NSB Native communities have, in fact, proven quite resilient to such effects by local voter insistence on these communities being "dry," and by the NSB's continued support of Inupiat cultural values and its strong commitment to health, social service, and other assistance programs.

Several salient points in the evaluation of possible sociocultural effects from oil-related developments due to oil and gas activities in the planning area should be made:

1. Change itself, even though induced primarily by forces outside the communities, does not necessarily cause the levels of psychic stress that lead to pathology but technological disasters, as opposed to natural disasters, have been shown to produce more long-term stresses on affected communities (Picou et al., 1992; Inkeles, 1973).
2. Related to the first point is the fact that not all sociocultural change (directly or indirectly related to oil development) may be negative. Higher levels of employment, better health programs, and improved public services must be viewed as possible positive sociocultural effects from oil development on the North Slope. Additionally, income from oil-industry revenue and employment could improve living conditions, although major dependence on a nonrenewable-resource-based economy could cause long-term social disruption at the time of resource depletion.
3. What drives the disruption of sociological change ". . . is the manner in which changes occur" (Murphy, 1965).
4. The conditions that make sociocultural change stressful must be viewed as ongoing. If the stressful conditions alter, the society can make successful adjustments to the changes that have occurred; and the rates of violence, suicide, and substance abuse will drop.

Nuiqsut is the most likely community in the region to experience additional sale-related effects in social health and well-being above those effects already experienced as a result of NSB CIP employment and the indirect effects from current oil development. These effects on social health could have direct consequences on the sociocultural system but would not have a tendency toward displacement of existing institutions above the displacement that already has occurred with the current level of development. Effects on the institutions and sociocultural systems in Barrow and Atqasuk would be periodic but not displace existing institutions.

Impacts from approaching oil and gas development now practically encircling the community of Nuiqsut are addressed by local residents more and more. In a 1996 public meeting for the Northstar project, a Nuiqsut elder stated that she wanted potential human-health issues that could result from the project looked into beforehand. She specifically expressed concern about cancers, health problems related to air pollution, and shortened lifespans (Northstar Project Community Meeting, Mar. 27, 1996; see Sec. IV.C.13., Subsistence).

Summary: Impacts on the sociocultural systems of communities in and near the planning area could occur as a result of disturbance from industrial activities (seismic activity, aircraft noise, supply-vessel traffic, construction, and oil spills); changes in population and employment; and effects on subsistence-harvest patterns. These effect agents could affect the social organization, cultural values, and social health of the communities.

Social institutions in all three communities would experience little direct disturbance from the staging of personnel and air freight expected for oil and gas activities in the planning-area exploration, development, and production; negligible effects would be expected to sociocultural systems, and no displacement of existing institutions would occur.

Social interaction of oil-industry workers with Nuiqsut residents could be long term, but there would not be a tendency toward displacement of their social institutions. Changes in population and employment are unlikely to cause disruption to sociocultural systems and would not displace existing institutions. Oil-spill employment is not likely to disrupt subsistence-harvest activities for an entire season (1 year) or create disruption to institutions and sociocultural systems, and would not displace existing institutions.

Under Alternative B, disturbance disruptions on Nuiqsut's subsistence resources are not likely to render important subsistence resources unavailable, undesirable for use, or available in reduced numbers or their pursuit more difficult for an entire season. The same would be true in Barrow and Atqasuk as a result of disturbance effects on subsistence resources. There would be no disruption to institutions and sociocultural systems expected.

Any effects on social health would have ramifications in the social organization, but NSB Native communities have, in fact, proven quite resilient to such effects with the NSB's continued support of Inupiat cultural values and its strong commitment to health, social service, and other assistance programs. Nuiqsut is the most likely community in the region to experience additional sale-related effects in social health and well-being above those effects already experienced as a result of NSB CIP employment and the indirect effects from current oil development. These effects on social health could have direct consequences on the sociocultural system but would not have a tendency toward displacement of existing institutions above the displacement that has already occurred with the current level of development. Effects on the institutions and sociocultural systems in Barrow and Atqasuk would be periodic and with no tendency to displace existing institutions. There is a likelihood for disproportionately adverse effects on Alaskan Natives as a result of the proposed action. Effects are expected to be focused on the Inupiat communities of Barrow, Atqasuk, and Nuiqsut within the North Slope Borough. The sociocultural and subsistence activities of these Native communities could be affected by routine development.

Conclusion—First Sale: Effects from management actions and oil and gas activities in the planning area under Alternative B are unlikely to disrupt sociocultural systems. Disturbance effects would be short term and would not be expected to disrupt or displace institutions and sociocultural systems, community activities and traditional practices for harvesting, sharing, and processing subsistence resources. Overall effects under Alternative B to the sociocultural systems of the communities of Barrow, Atqasuk, and Nuiqsut would be negligible.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative B increases from a range of 65 to 350 MMbbl and zero to one oilfields to a range of 90 to 500 MMbbl in zero to two oilfields. The number of exploration wells increases from a maximum of 4 to 14, delineation wells increase from a maximum of 6 to 12, and production wells increase from 83 to 150. Pipeline miles increase to 90 mi. Multiple sales would occur over a longer period of time and, depending on the frequency of sales, the timeframe for oil and gas activities in the planning area would extend to at least two decades.

For Alternative B, it is estimated that the number of spills <1 bbl would increase from a range of 0 to 53 spills to a range of 0 to 75 spills, and the number of spills >1 bbl would increase from a range of 0 to 17 spills to a range of 0 to 25 spills over the assumed production life of the planning area. The estimated number of crude oil spills over the assumed production life of the planning area would increase from a range of 0 to 70 spills to a range of 0 to 100 spills (Sec. IV.A.2).

If several lease sales occur under Alternative B, considerably more exploration activity is expected to occur in the southern half of the planning area, and the levels of effects due to noise, disturbance, and habitat alteration are expected to increase. Given that resource estimates and development scenarios project an increase in resources and an increase in the number of drill pads and pipeline miles, logic would assume an increase in the effects to potentially affected subsistence resources, except for the fact that these effects would be spread over 2 decades. The critical factor would be the timing between sales—a longer interval would allow more recovery to subsistence resources from aircraft, vehicular, and construction disturbance and subsistence practices from increased access conflicts; less of an interval might not allow for sufficient recovery. In any case, the cumulative effect would clearly be an increased development "footprint" and consequent increased habitat loss to resources and use are loss to hunters. This could affect subsistence harvests in the communities of Barrow, Atqasuk, and (especially) Nuiqsut and could alter caribou distributions sufficiently to make subsistence-hunter access more difficult.

Conclusion—Multiple Sales: Effects from management actions and oil and gas activities in the planning area for multiple sales under Alternative B could disrupt sociocultural systems for periods up to 1 year, but impacts would not be expected to displace institutions and sociocultural systems, community activities, or traditional practices for harvesting, sharing, and processing subsistence resources.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.C.7, Fish Resources, IV.C.8, Birds, IV.C.9, Mammals, and IV.C.10, Endangered and Threatened Species. Important proposed subsistence stipulations that would specifically protect subsistence practices and sociocultural systems include a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on the NPR-A. Additionally, important proposed Subsistence Stipulations would require lessees:

1. To monitor exploration, development, and production effects on subsistence.
2. To not unreasonably restrict subsistence access by establishing procedures for use and firearm discharge near oil facilities.
3. To notify BLM if conflicts arise between the lessee and subsistence hunters and that BLM resolve the issue.
4. To consult with local communities about siting, timing, methods of operation, and possible mitigation to assure that exploration, development, and production activities are compatible with subsistence practices. Local communities, the NSB, and the Subsistence Advisory Panel all will concurrently review any exploration, development and production plans, and any interested party may request that BLM resolve disputes that cannot be settled between the parties.
5. To provide an employee-orientation program that addresses environmental, social, and cultural concerns relating to the NPR-A.
6. To conduct an inventory of known traditional land use sites in order to develop a plan to avoid these sites and to mitigate any possible damage to them.

15. Coastal Zone Management: Under Alternative B, approximately 2.1 million acres would be available to leasing. The area excluded from possible leasing includes nearly the entire Beaufort Sea coast, areas around Teshekpuk Lake, and other fish-bearing lakes in the planning area. Surface resource protections exclude 2.3 million acres from oil and gas leasing. These excluded areas include the Teshekpuk Lake Watershed, Goose Molting Habitat, Spectacled Eider Nesting Concentrations, Teshekpuk Lake Caribou Habitat, Fish Habitat, Colville River Raptor, Passerine, and Moose Area, Umiat Recreation Site, Scenic Areas, Pik Dunes, Ikpikpuk Paleontological Sites, and Potential Colville Wild and Scenic River LUEA's. Although the LUEA's would be unavailable to leasing, aboveground pipelines would be permitted to cross all but the potential Colville Wild and Scenic River LUEA. These areas would be subject to restrictions for siting pipelines and industrial structures and seismic and exploratory drilling setbacks.

Federal lands within the NPR-A are excluded from the coastal zone; however, all uses and activities on Federal lands either occurring within the coastal zone or that may reasonably be expected to affect the coastal area and its resources must be consistent to the maximum extent practicable with enforceable standards of the ACMP, including state standards in 6 AAC 80 and enforceable policies of local district programs. The primary goal of the NSB's land management regulations and zoning ordinances is to protect the subsistence lifestyle of the Borough's largely Inupiat population, while also encouraging and managing economic development. The enforceable policies of the NSBCMP have been incorporated within the zoning ordinance in Section 19.70.050.

Major land uses on the North Slope are divided between traditional subsistence uses and hydrocarbon-development operations. Subsistence uses of the coastal resources in the NPR-A have been and will continue to be of the highest priority of the NSB Inupiat, given cultural and historic patterns of existence within NPR-A lands. Standards for development prohibit severe harm to subsistence resources or activities or disturbance of cultural and historic sites. Requirements address reasonable use of vehicles, vessels, and aircraft; engineering criteria for structures; drilling plans; oil-spill-control and -cleanup plans; pipelines; causeways, residential development associated with resource development; air and water quality; and solid-waste disposal.

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting management actions associated with Alternative B include aerial surveys (including that of wildlife) and ground activities, such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall, and overland moves, which occur during the winter on frozen tundra. These activities generally would be the same as Alternative A, except that the number and frequency of camps and moves would increase, depending on potential oil and gas exploration activity.

b. Oil and Gas Exploration and Development Activities: Alternative B involves several ground-impacting-management actions associated with oil and gas development. These include seismic surveys, exploration drilling, and the construction of gravel drill pads, roads, airstrips, pipelines; and possible oil spills (drill pad, pipeline, and supply vessel). Oil exploration activities would occur in winter (early December-mid-April). Transportation of construction materials, personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled, and moved inland the following winter. Under this alternative, one oilfield is assumed to be discovered and developed.

As previously indicated, the NPR-A is excluded Federal land and, while Federal lands are defined as being outside of the coastal zone, Federal activities must be reviewed for consistency with coastal management programs. Therefore, onshore activities within NPR-A and some offshore activities identified under Alternative B should be assessed against the ACMP, which includes the NSB CMP (Sec. III.C.5(b)).

While the NPR-A is technically outside the coastal zone, it is within the North Slope Borough. The NSB Comprehensive Plan and Land Management Regulations (LMR's) are applied to all developments occurring on private, Federal, and State lands. Activities could include portions of road/pipeline corridors, including the offshore portions (such as inlets and bays) within the NSB boundary. Development activities that occur adjacent to the Colville and Ikpikpuk rivers that could affect coastal resources or uses, including activities described in Exploration Plans and Development and Production Plans, could be subject to the Statewide standards and NSB district policies of the ACMP. All policies of the ACMP are examined herein for potential conflicts with effects from oil and gas exploration or development activities identified in Sections IV.C.1-14 and 16. While some policies may not directly apply to actions under Alternative B, they may apply to Alternatives C through E. Where applicable, to minimize redundancies, only those standards where potential conflicts with activities identified in Alternatives C through E may occur are examined in Sections IV.D.15 through IV.F.15.

Effects of Exploration and Development on the Alaska Coastal Management Program: Section 307(c)(3)(B) of the Federal Coastal Zone Management Act (CZMA) requires applicants to certify that each activity that is described in detail in an exploration or development and production plan that affects any land use or water use in the coastal zone complies with, and will be implemented consistent with, the State's coastal program. The State would concur with or object to an applicant's certification. The State reviews exploration and development and production plans to determine if activities that could affect the coastal zone are consistent with the ACMP.

In the following discussion, ACMP uses and activities standards would relate to Alternatives B through E and to potential effects identified for each alternative in other resource sections of this EIS (Secs. IV.B.1-14 and 16 through IV.E.1-14 and 16). Policies of the NSB CMP are assessed in conjunction with the most closely associated Statewide standard. The NSB CMP policies have been incorporated into the NSB LMR's. The corresponding LMR policy number is listed following that of the NSB CMP policy.

This analysis is not a consistency determination pursuant to the Coastal Zone Management Act of 1972, as amended, nor should it be used as a local planning document. It is highly unlikely that the activities or events that are hypothesized will occur as assumed in this EIS. It is unknown at this time which of the alternatives, or any combination thereof, may be selected in BLM's record of decision. If one or more lease sales occur, the projected exploration and development activities in this EIS may be changed by lessees as they explore, develop, and produce petroleum products from leases offered for sale, and could affect the accuracy of this assessment.

(1) Coastal Development (6 AAC 80.040): Water dependency is a prime criterion for development along the shoreline (6 AAC 80.040 [a]). The intent of this policy is to ensure that onshore developments and activities that can be placed inland do not displace activities dependent upon shoreline locations. No activity under Alternative B would require a shoreline location, since the entire Beaufort Sea coast within the NPR-A planning area is excluded from leasing under this alternative. Although large equipment could be barged outside the NPR-A to coastal staging areas in the summer and stockpiled until winter, no development activity would conflict with this policy.

(2) Geophysical Hazard Areas (6 AAC 80.050): This Statewide standard requires coastal districts and State agencies to identify areas in which geophysical hazards are known and in which there is a substantial probability that geophysical hazards may occur. Development in these areas is prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life have been provided.

Permafrost, faults and earthquakes, hydrates and shallow gases, and factors affecting the geotechnical characteristics of the planning area must be considered. Onshore development would be sited in areas of permafrost. Development in these areas must "maintain the natural permafrost insulation quality of existing soils and vegetation" (NSB CMP 2.4.6[c] and NSBMC 19.70.050.L.3). No conflict with this policy is anticipated under this alternative.

(3) Recreation (6 AAC 80.060: This Statewide standard requires coastal districts to designate areas for recreational use if (1) the area receives significant use by persons engaging in recreational pursuits or is a major tourist destination; or (2) the area has potential for high quality recreational use because of physical, biological or cultural features. High priority is given to maintaining or increasing public access to coastal waters. The NSB has identified many areas within NPR-A as high recreational use areas. No conflict with these policies is anticipated under Alternative B.

(4) Energy Facilities (6 AAC 80.070): The ACMP requires that decisions on the siting and approval of energy-related facilities be based, to the extent feasible and prudent, on 16 criteria within the energy facilities standard. No conflict with these policies is anticipated under Alternative B.

Other criteria within this standard require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability (6 AAC 80.070 [3]). The NSB CMP also requires that "transportation facilities and utilities must be consolidated to the maximum extent possible" (NSB CMP 2.4.5.2[f] and NSBMC 19.70.050. K.6).

Construction associated with energy-related facilities under Alternative B also must comply with siting standards that apply to all types of development. These more general standards are discussed later under Habitats and Air, Land, and Water Quality.

(5) Transportation and Utilities (6 AAC 80.080): This Statewide standard requires that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches. No conflict with these policies is anticipated under Alternative B.

The NSB CMP contains several additional policies related to transportation that may be relevant to this analysis. All but one of the policies are "best-effort policies" and subject to some flexibility if (1) there is a significant public need for the proposed use and activity, (2) all feasible and prudent alternatives have been rigorously explored and objectively evaluated, and (3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent. "Transportation development, including pipelines, which significantly obstructs wildlife migration" is subject to the three conditions listed above (NSB CMP 2.4.5.1[g] and NSBMC 19.70.050.J.7). Section IV.C.9 indicates that interference with caribou movements would be temporary and brief; caribou migrations and overall distribution are not expected to be affected. Therefore, under Alternative B, conflict with this policy is not anticipated.

As noted in the previous standard for energy facilities, transportation facilities are expected to be consolidated to the maximum extent practicable. Therefore, there should be no conflict with either NSB CMP 2.4.5.1(i) (NSBMC 19.70.050.J.9), which discourages duplicative transportation corridors from resource-extraction sites, or NSB CMP 2.4.5.2(f) (NSBMC 19.70.050.K.6), which requires that transportation facilities and utilities be consolidated to the maximum extent practicable.

The NSB CMP 2.4.6(b) (NSBMC 19.70.050.L.2), under the category of "Minimization of Negative Impacts," requires that alterations to shorelines, water courses, wetlands, and tidal marshes and significant disturbance to important habitat associated with transportation and utilities be minimized. In the discussion of habitats Sections IV.C.6-9, it is recognized that alterations to wetland habitat and ponds and lakes will occur and birds could be disturbed during construction. This policy also requires that periods critical for fish migration be avoided. These requirements identify constraints for the siting, design, construction, and maintenance of transportation and utility facilities. Also, stipulations identified in Section II provide protections to resources and habitats. Therefore, under Alternative B, conflict with this standard is not anticipated.

(6) Mining and Mineral Processing (6 AAC 80.110): Extraction of sand and gravel is a major concern on the North Slope. Gravel resources are needed for construction of pads, roadbeds, berms or causeways, and docks to protect the tundra. The ACMP Statewide standards require that mining and mineral processing be compatible with the other standards, adjacent uses, and activities, state and national needs, and district programs (6 AAC 80.110 [a]). Sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits when no feasible and prudent noncoastal alternative is available to meet the public need (6 AAC 80.110 [b]). Substantial alteration of shoreline dynamics is prohibited (NSB CMP 2.4.5.1[j] and NSBMC 19.70.050.J.10). Constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters, if gravel is not obtained from inland sites, and to ensure floodplain integrity (NSB CMP 2.4.5.2[a] and [d] and NSBMC 19.70.050.K.1 and 4). Given the extraction required to support oil and gas development anticipated under Alternative B in conjunction with stipulations 34 and 40, no conflicts with the ACMP or NSB policies are anticipated.

(7) Subsistence (6 AAC 80.120): The Statewide standard for subsistence guarantees opportunities for subsistence use of coastal areas and resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. Under Alternative B, the entire Beaufort Sea coast within the NPR-A planning area is excluded from leasing, significantly reducing potential disturbance to bowhead whales and other marine mammals. However, access to subsistence resources, subsistence hunting and resource use could be affected by reductions in subsistence resources and changes in subsistence-resource-distribution patterns. These changes could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities that include pipeline construction; structure placement; and support-base, pump-station, and road construction. Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals would have no apparent effect on subsistence harvests for Barrow, Atqasuk and Nuiqsut hunters. Subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under Alternative B, and from protections afforded by stipulations identified in Section II to protect marine and terrestrial mammals, waterfowl, and fishing resources. Surface, air, and foot traffic near the oilfields is expected to increase under Alternative B and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. This conclusion is based partially on the established policy that roads and pipelines are constructed to provide for unimpeded wildlife crossings. Based on the analysis of disturbance effects of activities on caribou described in Section IV.C.9 and subsistence described in Section IV.C.13, potential conflict with the subsistence policies under Alternative B is not anticipated.

Policy 2.4.3(d) (NSBMC 19.70.050.D) requires that development not preclude reasonable subsistence-user access to a subsistence resource. Onshore pipelines and construction activities could cause disruptions to subsistence caribou harvests from access and movement conflicts, but effects are expected to be short term. Where access is reduced or restricted, development can occur only if no feasible or prudent alternative is available, and then it is subject to the conditions of best-effort policies. Conflict with these standards and policies will also be minimized under Alternative B by the exclusion of the Teshekpuk Lake Caribou Habitat LUEA from leasing.

Several important NSB CMP policies relate to adverse effects on subsistence resources. The NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) addresses "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems." Temporary reductions in subsistence resources and changes in subsistence resource-distribution patterns could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities including offshore dredging, pipeline construction, structure placement and onshore pipelines, and support-base, pump-station, and road construction.

All NPR-A development scenarios for Alternatives B through E call for an onshore pipeline for oil delivery to TAPS, and potential for a pipeline spill contaminating the Colville River. A spill entering the Colville potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting could substantially affect the subsistence harvest (Sec. IV.C.13). However, given that the number and size of oil spills estimated in Alternative B would be small, and that chronic spills can normally be contained on the drill pad, it is anticipated that the effects from spills and potential disruption from cleanup activities would have little to no impact on subsistence resources and harvest patterns.

Conflict with these policies is possible during the exploration, development, and production phases, but is more likely during development and production increases in the unlikely event of an oil spill and associated oil-spill-cleanup activities. No conflict with this policy is anticipated under Alternative B.

(8) Habitats (6 AAC 80.130): The Statewide standard for habitats contains an overall standard policy plus policies specific to eight habitat areas: offshore areas; estuaries; wetlands and tideflats; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes, and important upland habitat (6 AAC 80.130 [a], [b], and [c]). Activities and uses that do not conform to the standards may be permitted if there is significant public need and no feasible prudent alternatives to meet that need, and all feasible and prudent measures are incorporated to maximize conformance (6 AAC 80.030 [d]). The NSB CMP contains a district policy that reiterates the applicability of the Statewide standard (NSB CMP 2.4.5.2[g] and NSBMC 19.70.050.K.7), plus several others that augment the overall policy or can be related to activities within a specific habitat. Under Alternative B, areas excluded from leasing include the Teshekpuk Lake Watershed, Goose Molting Habitat, Spectacled Eider Nesting Concentrations, Teshekpuk Lake Caribou Habitat, Fish Habitat, Colville River Raptor, Passerine, and Moose Area, Umiat Recreation Site, Scenic Areas, Pik Dunes, Paleontological Sites, and Potential Colville Wild and Scenic River LUEA's. Also, special stipulations have been developed to provide protection for birds, terrestrial mammals, and fish (Section II). Therefore, conflicts for exploration under Alternative B are not anticipated.

The ACMP Statewide standard for habitats in the coastal zone requires that habitats "be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources" (6 AAC 80.130 [b]). This overall policy is supported by an NSB CMP policy requiring that development "be located, designed, and maintained in a manner that prevents significant adverse impacts on fish and wildlife and their habitat, including water circulation and drainage patterns and coastal processes" (NSB CMP 2.4.5.2[b] and NSBMC 19.70.050.K.2). In addition, "vehicles, vessels, and aircraft that are likely to cause significant disturbance must avoid areas where species that are sensitive to noise or movement are concentrated at times when such species are concentrated" (NSB CMP 2.4.4 [a] and NSBMC 19.70.050.I.1). Some disturbances associated with exploration and development would be mitigated by stipulations placed on permits. The analyses in Sections IV.B.6 through 14 indicate that resources would not be subject to significant disturbance from these activities. Although there are no conflicts with the reasonably foreseeable activities under this proposal at this point, some activities that may appear as specific proposals are brought forward at the time of development.

Activities may affect several of the habitats identified in the Statewide standard, including lagoons, wetlands, rivers, lakes, and streams. Much of the uplands in the NSB are considered wetlands. Therefore, onshore-development activities would need to be designed and constructed to avoid (1) adverse effects to the natural drainage patterns, (2) destruction of important habitat, and (3) the discharge of toxic substances (6 AAC 80.130 [c][3]). Water impoundments created by a pipeline/road corridor would have both positive and negative effects. In localized areas near the pipeline-road complex (Sec. IV.B.8), impoundments would benefit some waterfowl by creating additional habitat but displace other nesting shorebirds.

Caribou of the CAH and TLH are expected to be disturbed and their movements delayed along the pipeline during periods of air overflights (i.e. pipeline inspections), but disturbances are not expected to affect migrations and overall distribution (Sec. IV.C.9). Surface, air, and foot traffic near the oilfields is expected to increase under Alternative B and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. This conclusion is based partially on the established policy that roads and pipelines are constructed to provide for unimpeded wildlife crossings. The NSB CMP policy 2.4.6(e) (NSBMC 19.70.050.L.5) emphasizes this practice and provides a set of guidelines and an intent statement specifically to implement the policy. There is no inherent conflict between the crossing requirements and the assumed activities. If a spill occurred as a result of activities under Alternative B, it is expected to result in the loss of no more than small numbers of terrestrial mammals, with recovery expected within about a year (Sec. IV.B.9).

Rivers, lakes, and streams are managed to protect natural vegetation, water quality, important fish or wildlife habitat, and natural water flow (6 AAC 80.130 [c][7]). Pipeline and road construction, including gravel extraction, could affect these waterways and would need to be conducted in a manner that ensures the protection of riverine habitat and fish resources. Gravel extraction also is regulated under policies that are described in the section on mining. No conflict with this policy is anticipated under Alternative B.

(8) Air, Land, and Water Quality (6 AAC 80.140): The air, land, and water quality standard of the ACMP incorporates by reference all the statutes pertaining to, and regulations and procedures of, the ADEC. The NSB reiterates this standard in its district policies and emphasizes the need to comply with specific water and air quality regulations in several additional policies.

Water quality can be affected by oil spills, deliberate discharges and emissions, and gravel operations. As a precaution against accidental spills, the NSB CMP requires the use of impermeable lining and diking for fuel-storage units with a capacity >660 gal (NSB CMP 2.4.4[k] and NSBMC 19.70.050.I.11). In addition, development within 1,500 ft of a coast, lake, or river shoreline "that has the potential of adversely impacting water quality (e.g., landfills, or hazardous-materials storage areas, dumps, etc.)" must comply with the conditions of the best-effort policies (NSB CMP 2.4.5.1[e] and NSBMC 19.70.050.J.4). These conditions are: (1) there must be a significant public need, (2) the developer has rigorously explored and objectively evaluated all feasible and prudent alternatives and cannot comply with the policy, and (3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent. There may be some short-term conflict with water quality due to potential oil spills between this policy and activities assumed under Alternative B.

Some discharges and emissions would occur during exploration and development, and the NSB CMP policy 2.4.4(c) (NSBMC 19.70.050.I.3) requires that "development resulting in water or airborne emissions. . .comply with all state and federal regulations." This is consistent with the Statewide standard.

Discharges of muds, cuttings, and drilling fluids are regulated closely. Formation waters produced from the wells along with the oil are regulated through a USEPA NPDES permit and, depending on the conditions of the permit, may be disposed of above- or belowground. If formation waters were reinjected or injected into a different formation, no discharge of formation waters would occur and no effect would occur.

Because discharges are carefully regulated, no conflict is anticipated with the Statewide standard or NSB CMP policy 2.4.4(d) (NSBMC 19.70.050.I.4), which requires that "industrial and commercial development. . .be served by solid waste disposal facilities which meet state and federal regulations." Any onshore development under Alternative B must meet the Statewide standard and the district policy related to solid-waste disposal. Assuming the regulations are implemented properly, there is no inherent conflict between the proposed activities and the ACMP water-quality provisions.

Air quality also must conform with Federal and State standards (6 AAC 80.140, NSB CMP 2.4.3[i] and 2.4.4[c], and NSBMC 19.70.050.H and I.3). The analysis of air-quality effects under Alternative B in Section IV.C.5 indicates that conformance is anticipated, and no conflict between air quality and coastal policies should occur.

(10) **Statewide Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150)**: The ACMP Statewide standard requires that coastal districts and appropriate State agencies identify areas of the coast that are important to the study, understanding, or illustration of national, State, or local history or prehistory.

The NSB developed additional policies to ensure protection of its heritage. The NSB CMP 2.4.3(e) (NSBMC 19.70.050.E) requires that development that is "likely to disturb cultural or historic sites listed on the National Register of Historic Places; sites eligible for inclusion in the National Register; or sites identified as important to the study, understanding, or illustration of national, state, or local history or prehistory shall (1) be required to avoid the sites; or (2) be required to consult with appropriate local, state and federal agencies and survey and excavate the site prior to disturbance." The NSB CMP 2.4.3(g) (NSBMC 19.70.050.G) goes on to require that "development shall not cause surface disturbance of newly discovered historic or cultural sites prior to archaeological investigation." These NSB CMP policies establish clearly what is required. Although the NPR-A technically is excluded from the coastal area, given the number of existing sites, it is likely that new cultural and paleontological sites may be discovered under Alternative B. However, we do not anticipate conflicts with these policies, since stipulation 66 requires an inventory of traditional use sites prior to conducting any activities.

Traditional activities at cultural or historic sites also are protected under the NSB CMP 2.4.3(f) (NSBMC 19.70.050.F) and 2.4.5.2(h) (NSBMC 19.70.050.K.8). As noted in the discussion of policies related to subsistence, the latter is a best-effort policy that requires protection for transportation to subsistence-use areas as well as cultural-use sites. There is no inherent reason to assume conflict with these policies.

Summary: Alternative B is expected to increase the level of noise and disturbance and habitat alteration effects on terrestrial mammals in parts of the planning area over the level of effects under Alternative A. However, conflicts with coastal management policies and standards of the ACMP and NSB CMP are not anticipated under Alternative B. Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters would have no apparent effect on subsistence harvests in these communities (Sec. IV.C.13). Under Alternative B, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative and from the protection afforded by other management actions, including protective stipulations placed on activities.

Potential conflict between Alternative B proposed activities and Statewide standards and NSB district policies are may arise, but are not expected, in conjunction with the NSB CMP 2.4.5.2(h) (NSBMC 19.70.050.K.8) that relates to both subsistence and cultural resource areas. This policy requires that development be located, designed, and maintained so as not to interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence-use areas. Also, conflict with district policies may arise in the potential for adverse effects to subsistence resources. NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) relates to "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems." Potential conflicts with these standards will be minimized by stipulations developed for this lease sale.

Conclusion—First Sale: For Alternative B, conflicts could occur with specific Statewide standards and NSB CMP policies related to potential user conflicts between development activities and access to subsistence resources. Conflicts are possible with the NSB CMP policy related to adverse effects on subsistence resources resulting from periodic disturbance and oil spills, but no resource would become unavailable, undesirable for use, or experience overall population reductions. These effects would occur in the unlikely event of spilled oil contacting subsistence resources and habitats and the activities associated with oil-spill cleanup. No conflicts are anticipated during exploration, since no oil spills are assumed to occur during exploration.

Multiple Sales: Under a multiple-sales approach, under Alternative B, resource estimates increase to 90 to 500 MMbbl and up to two oilfields, exploration wells to 14, delineation wells to 12, and production wells to 150. Pipeline miles increase to 90 mi. Multiple sales would occur over a longer period of time and, depending upon the frequency of sales, the time frame for oil and gas activities in the planning area would extend to at least 20 years. The estimated number of crude oil spills over the assumed production life of the planning area would increase from a range of 0 to 70 spills to a range of 0 to 100.

If several sales occur under Alternative B, considerably more exploration activity is expected to occur in the southern half of the planning area, and the levels of effects due to noise, disturbance, and habitat alteration is expected to increase. Surface, air, and foot traffic near oilfield facilities is expected to increase and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year (Sec. IV.C.9). For arctic fish populations, each additional lease sale is expected to have similar effects on arctic fish as described for one sale under Alternative B. However, if there are increased levels of activity associated with future lease sales, and/or insufficient recovery time between sales, greater adverse effects than described for a single sale under Alternative B are likely to occur. An increase in effects to bird populations from increased noise disturbance could be expected with multiple sales. Surface, air, and foot traffic are expected to increase somewhat near oilfield facilities with multiple sales, and to displace greater numbers of individuals and involve more species than with a single sale, though the increase is not expected to significantly affect populations. Effects from disturbance and habitat alteration or loss on birds is expected to increase in the southern half of the planning area with multiple sales under Alternative B. Effects from small, chronic oil spills are expected to have a similar effect on birds and their habitats as under Alternative B with the first sale but with increased numbers of species involved and increased loss of individuals; habitat contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods data available. (Sec. IV.C.8)

Effects of multiple sales on bowhead whales are expected to be essentially the same as described for the first sale. Bowhead whales exposed to noise-producing activities such as marine-vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Small onshore spills are unlikely to reach the marine environment. If spilled oil did reach the marine environment, it is assumed to be a very small amount, and any exposure to spilled oil would not pose serious direct effects to bowhead whales. For marine mammals, multiple sales under Alternative B are expected to have similar effects to those described earlier for one sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole

Conclusion—Multiple Sales: Displacement of birds from disturbance and habitat alternation is expected with multiple sales, but should not significantly affect coastal plain bird populations. Effects from multiple sales to terrestrial mammals are expected to increase, but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude-oil and fuel spills, but populations are expected to recover within 1 year (Sec. IV.C.9). Arctic fish populations would experience effects from seismic surveys and pipelines similar to those discussed for the first sale (i.e., no measurable effect on arctic fish populations). However, fuel and oil spills are likely to have a greater effect on fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated for multiple sale. Increased disturbance and displacement effects and increased oil-spills risks are expected to increase for birds in the southern half of the planning area under Alternative B with multiple sales, but not significantly affect coastal plain populations. Bowhead whales exposed to noise-producing activities such as marine-vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Effects of multiple sales and increased potential for noise-producing activities and oil spills to marine mammals would be short term and local with no adverse effects to populations. Multiple sales may cause potential conflicts with the subsistence, habitat, air- and water-quality, and transportation standards of the ACMP; however, each oil and gas lease operating plan will be reviewed for consistency on a case-by-case basis.

Effectiveness of Stipulations: Stipulations described in Section II.C.7, including ice roads and water use, overland moves, and construction measures, solid- and liquid-waste handling and disposal, fuel handling and spill cleanup, general environmental stipulations, and aircraft restrictions are expected to minimize effects to terrestrial mammals, birds, and fish. These stipulations would minimize disturbance from most factors and prevent fuel or oil spilled on pads from reaching surrounding habitats and would protect subsistence resources. No stipulations or other special mitigating measures are anticipated to protect bowhead whales, since development activities would be focused southward, away from the coast. Section II.C.7 contains stipulations proposed by BLM to protect various waterfowl species from various activities in the planning area. Stipulations included under several categories, such as solid- and liquid-waste handling, hazardous-material disposal and cleanup, ice roads and water use, overland moves and seismic work, oil and gas exploratory drilling, facility design and construction, ground transportation, air traffic, oilfield abandonment, orientation program, and other activities should provide adequate protection to eiders from most activities.

The effectiveness of stipulations for noise and disturbance from aircraft traffic associated with activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, are the same as Alternative A. Aircraft traffic associated with activities other than oil and gas has the potential to affect breeding and nesting eiders, because several of the aircraft stipulations pertaining to flight-timing restrictions apply only to oil and gas activities. Therefore, the stipulations associated with flight-timing restrictions of aircraft probably are not adequate to protect spectacled eiders and Steller's eiders from disturbance from aircraft associated with aerial wildlife surveys and other surveys conducted in the lake areas to the north, west, and east of Teshekpuk Lake (Sec. IV.C.10). Steller's eiders in other portions of the planning area are less likely to be affected by aircraft flights, because fewer flights are likely to be conducted in those areas. Disturbance of some individuals over the life of the project is expected to be unavoidable.

In addition to specific resource protection stipulations developed to protect fish, birds, mammals, and endangered and threatened species, subsistence Stipulations 61 through 63, orientation program Stipulation 65, and traditional land use site Stipulation 66 have been identified to protect subsistence practices under Alternative B. Proposed subsistence Stipulation 64 would specifically protect subsistence practices by requiring an Subsistence Advisory Panel be established to monitor subsistence issues and concerns arising from and oil and gas activity on the NPR-A. Other measures require monitoring of exploration, development, and production effects on subsistence; prohibit unreasonable restrictions on subsistence access by establishing procedures for use and firearm discharge near oil facilities; and require consultation with local communities about siting, timing, methods of operation, and possible mitigation so that oil and gas activities are compatible with subsistence practices and to encourage a conflict resolution agreements.

16. Recreation and Visual Resources:

a. Activities Other than Oil and Gas Exploration and Development: The kinds of activities other than oil and gas exploration and development expected under Alternative B are the same as under Alternative A. However, certain of these activities would increase as a result of and in support of oil and gas development. For example, field activities associated with archeological site clearances, such as camps, excavations, and aircraft activity all likely would increase. The resulting impacts would be minimal and short term in nature as described under Alternative A, but the total area impacted could increase to 2,000 acres (from 1,500 in Alternative A).

The longer lasting visual impacts of green trails under Alternative B are expected to remain about the same as those under Alternative A, even though the amount of supplies and material transported by winter overland moves may increase This is because these moves generally follow the same route; therefore, neither the length nor number of green trails in some phase of recovery is expected to noticeably increase.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Under this alternative, seismic-survey work would continue but would increase from one operation (under Alternative A) to two to three and would include 3-D as well as 2-D operations. Assuming two crews working per season, ongoing seismic operations are expected to affect no more than approximately 1,000 acres at a time, or about 500 acres more than under Alternative A. Green trails (see Alternative A) resulting from these operations could increase severalfold from Alternative A with hundreds of miles of intermittent green trail being visible during any one summer season.

A total of 10 exploration/delineation wells are anticipated under this alternative. However, due to the limited number of drill rigs available, no more than one well is anticipated to be drilled at any one time. Drilling would occur over several winter seasons using ice pads, roads, and airstrips. Temporary on site location of structures (e.g., drill rigs); noise from generators, vehicles, aircraft etc.; human presence; and associated activity all would have adverse, short-term impacts on scenic quality, solitude, naturalness, or primitive/unconfined recreation during the winter season. These impacts are expected to be greatest within a 2-mi radius of the drill site, which is an area of approximately 8,000 acres per well site. Accordingly, under this alternative, there would be a temporary loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation around over an area of approximately 8,000 acres.

In addition to the short-term impacts that result from ongoing exploratory drilling operations , an accumulating summer-season visual concern exists as a result of the greening of vegetation under vacated ice pads, airstrips, and roads. This direct impact to the area's naturalness is a result of the same conditions that create green trails—the greater availability of moisture and nutrients as ice or compacted snow melts. This greening of the vegetation does not necessarily develop wherever ice pads are constructed or snow is compacted but when it does, it can be very detectable from the air for 2 to 5 years or longer. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site , as many as 500 acres (10 vacated sites x 50 acres/site) will be in various states of recovery from this greening effect.

Exploration wells also will leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 ft tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet.

(2) Development: A total of as many as two production pads and 75 mi of pipeline are anticipated under this alternative. Although with the cessation of construction activities and closure of material sites, the intensity of impacts likely would be reduced from the development phase to the production phase, remaining structures, human presence, and associated activity and noise all would have adverse impacts on scenic quality, solitude, naturalness, or primitive/unconfined recreation during the life of the field. Because production could occur for 30 years, impacts would be long term. These long-term, adverse impacts are expected to be greatest within 2 mi of the pad site (or an area of about 8,000 acres). Additionally, pipelines and associated facilities would impact recreation values. Pipelines are expected to be elevated only about 5 ft and, except during construction and repair, there would be no associated on-the-ground activity. Therefore, long-term impacts to recreation values from pipelines are expected to be minimal beyond about ½ mi. This equates to about 640 acres per mile of pipeline. Under this alternative, a single pump station also is expected along the route of a pipeline. Adverse impacts to recreation values would be similar to those resulting from a production pad and its facilities, or about 8,000 acres impacted per pump station. Accordingly under this alternative, there would be a long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 72,000 acres (i.e., [8,000 acres/pad x 2 pads] + [8,000 acres/pump station x 1 pump station] + [640 acres/mi x 75 mi of pipeline]). Short-term, routine/daily inspection flights also will impact solitude and naturalness along the length of all pipelines as long as they are in use.

Effects of Spills: Most spills (65-80%) will be confined to a pad. Spills not confined to a pad usually are confined to the area immediately around the pad or pipeline. Therefore, impacts on scenic quality, solitude, naturalness, or primitive/unconfined recreation resulting from spills likely would be confined to the same area described above under (2) Development.

A large spill that reaches a river and moves rapidly downstream would have disastrous short-term (and possibly long-term) impacts on recreation values.

Impacts to Wild and Scenic River Values: Under this alternative, resources on Federal lands and waters on and along the Colville River will receive the full protection of a "wild river" as afforded by the WSR Act (Appendix G). Therefore, no impacts to outstandingly remarkable river values are anticipated on BLM-managed lands/waters. However, the majority of lands and resources along that portion of the Colville proposed for WSR designation *are* not under BLM management or protection.

Conclusion—First Sale: As compared to Alternative A, there would be an increase of approximately 500 acres to 2,000 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. Short-term impacts from ongoing oil and gas exploration activities would impact approximately 9,000 acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would impact about 500 acres. Seismic operations would result in several hundred miles of green trails, possibly double those of Alternative A.

Oil and gas development would result in the long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 72,000 acres (or 1.6% of the planning area) for the life of production fields and pipelines.

Multiple Sales: The types of impacts resulting from additional lease sales would be the same as described above for the first sale. Short-term impacts such as green trails and pads, disturbance from noise, aircraft, and other ongoing activities would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would accumulate to the extent such facilities are necessary to support additional exploration and production. It is anticipated that such facilities will increase about 40 percent over those of the first sale and would affect a total of approximately 90,000 acres.

Conclusion—Multiple Sales: Long-term impacts would increase about 40 percent over those of the first sale, ultimately affecting about 90,000 acres or 1.9 percent of the planning area.

Effectiveness of Stipulations. The Colville River upstream from about Ocean Point would be designated Visual Management Class I under this alternative. As such, very limited management activity is allowed. Any contrast created within the characteristic landscape must not attract attention. These management standards will prevent any impacts to visual recreation values in this scenic and important recreation area.

Also of importance is that short-term impacts to recreation values from exploratory oil and gas activities, as well as overland moves, are significantly mitigated by being restricted to winter months. Few recreationists visit the area in winter months.

D. ALTERNATIVE C: Alternative C would include BLM's management actions described for Alternative A and a proposal for making about 3.4 million acres of the Northeast NPR-A Planning Area available to oil and gas leasing. This alternative focuses protection on certain high-value resources by making important waterfowl and caribou habitat unavailable to oil and gas leasing; the status of the LUEA's for oil and gas leasing under Alternative C is shown in Table IV.D-1. Seismic activities would be permitted throughout the planning area. Applicable stipulations identified in Section II.C.7 will be applied to this alternative. In addition, the alternativr includes (1) recommending the Colville River be included as a "scenic" river in the Wild and Scenic River System, (2) proposing a Bird Conservation Area that would incorporate part of the Colville River valley, (3) urging the creation of a Special Area designated by the Secretary of the Interior along the Ikpikpuk River to protect paleontological resources, and (4) recommending the addition of the Pik Dunes LUEA to the Teshekpuk Lake Special Area.

The types of activities that might impact the resources include those noted for Alternative A and those additional activities associated with oil and gas exploration and development as noted for Alternative B. The level of activities other than oil and gas would be similar to or slightly greater for Alternative C than for Alternative A (Table IV.A.1.a-1). The economically recoverable oil resources for the first sale are estimated to range from 75 to 410 MMbbl; Table IV.A.1.b-4. The oil resources estimated for Alternative C are greater than those estimated for Alternative B (Table IV.A.1.b-4) and, thus, the levels of activities associated with Alternative C also are estimated to be greater than they are for Alternative B. These activities include drilling 4 to 15 exploration and delineation wells, constructing one to two production pads, drilling 23 to 122 production and service wells, and constructing 10 to 90 mi of pipeline (Table IV.A.1.b.5). If the area available for oil and gas leasing under Alternative B results in multiple sales, 110 to 580 MMbbl of oil are estimated to be recovered (Table IV.A.1.b-6). The types of activities associated with multiple sales would be similar to those that might occur as the result of the first sale. The level of activities for multiple sales is shown in Table IV.A.1.b-7.

1. Soils: The types of activities that may affect soils under Alternative C include those analyzed under

Table IV.D-1
Land Use Emphasis Areas Status for Oil and Gas Leasing Under Alternative C[1]

Land Use Emphasis Area	Fig. No. II.B.	Oil and Gas Leasing Status
Teshekpuk Lake Watershed	1	The northern part of the LUEA including Teshekpuk Lake would be unavailable for leasing. The southern part of the watershed would be available for leasing.
Goose Molting Habitat	2	Unavailable
Spectacled Eider Nesting Concentrations	3	Unavailable
Teshekpuk Lake Caribou Habitat	4	Unavailable
Fish Habitat	5	Fish habitat in and along Teshekpuk Lake, the northern part of the Ikpikpuk River, and Miguakiak River would be unavailable for leasing. Fish habitat in the central part of the planning area, along the southern part of the Ikpikpuk River adjacent to the planning area, the Colville River, and Fish and Judy creeks would be available for leasing.
Colville River Raptor, Passerine, and Moose Area	6	Available
Umiat Recreation Site	8	Available
Scenic Areas	9	Available
Pik Dunes	10	Available
Ikpikpuk Paleontological Sites	11	The northern part of the Ikpikpuk River would be unavailable for leasing. The southern part of the Ikpikpuk River adjacent to the planning area would be available for leasing.
Kuukpik Corporation Entitlement	13	Available
Potential Colville Wild and Scenic River	14	Available

[1] Section II.

Alternatives A and B.

a. Activities Other than Oil and Gas Exploration and Development: The effects of management actions described under Alternative C are similar to Alternative A, except there may be an increase in excavations (see vegetation, Sec. IV.D.6).

b. Oil and Gas Exploration and Development Activities: Under Alternative C, the impacts from exploratory drilling and development activities would be the same as under Alternative B, except there would be an increase in the estimated level of activities. These activities could result in an estimated permanent loss of soils (based on loss of vegetation as noted in Sec. IV.D.6). Impacts to soils from spills and spill cleanup also are similar in area to those with impacts to vegetation.

Conclusion—First Sale: Estimated areas of impacts and losses of soils from all activities are similar to those areas discussed under vegetation.

Multiple Sales: Additional lease sales under Alternative C would result in additional exploration and development activities. The area of impacted soils is closely related to that of the disturbed vegetation (see Vegetation, Sec. IV.D.6, for acreage details).

Conclusion—Multiple Sales: Areas of impacts and losses of soils from all activities in multiple sales would be similar to those areas discussed under Vegetation (Sec. IV.D.6).

Effectiveness of Stipulations: There are no stipulations beyond those identified in Sec. II.C.7 that could reduce the impacts to soils.

2. Paleontological Resources:

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Paleontological resources (plant and animal fossils) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative C, the management-action impacts generally are the same as under Alternative A, except the intensity of the actions would increase due to potential oil and gas exploration.

(2) Oil and Gas Exploration and Development Activities: Paleontological resources are not ubiquitous in the planning area as are wildlife and habitat, and their occurrence is much less predictable. As a result, it is quite possible that no oil and gas exploration or development activities would impact a paleontological resources locale.

(a) Effects of Disturbance from Exploration: The types of oil and gas exploration activities that would occur under Alternative C would be the same as those that would occur under Alternative B. However, the level or intensity of these exploration activities would increase under Alternative C. The number of exploration/delineation wells drilled would increase from 10 to 15, and as many as 3 might be drilled during a single winter season. This would increase the probability of potential impact by 50 percent over Alternative B.

(b) Effects of Exploration Spills: These effects would be the same as those under Alternative B, except the probability of impacts would be increased by 50 percent.

(c) Effects of Disturbance from Development: The types of oil and gas development activities that would occur under Alternative C would be the same as those that would occur under Alternative B. However, the level or intensity of these development activities would increase under Alternative C. While the number of production pads and pump stations is expected to remain the same as in Alternative B, crude-oil-pipeline miles would increase by 15 for a total of 90 mi under Alternative C. This would increase slightly the probability of potential impact over Alternative B.

(d) Effects of Development Spills: These effects would be the same as those under Alternative B, although the probability of spills would be slightly increased.

Conclusion—First Sale: Under Alternative C, the probability of impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature but may be somewhat increased in magnitude over Alternative B. Under Alternative C, most of the impacts to paleontological resources would result from oil and gas exploration and development. When compared with Alternative B, the potential for impact to paleontological resources may range from similar to Alternative A to somewhat greater under Alternative C.

Multiple Sales: The potential impacts to paleontological resources under Alternative C could increase by as much as 20 percent compared to Alternative B.

Conclusion—Multiple Sales: Under Alternative C, potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative

B, but the probability of impacts occurring would increase. Under Alternative C, the potential impacts to paleontological resources from oil and gas exploration and development would increase by roughly 20 percent compared to Alternative B.

Effectiveness of Stipulations: The effectiveness of stipulations would be the same as under Alternative B.

3. Water Resources:

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may affect water resources under Alternative C would be similar to those in Alternative A, except that the number and frequency of camps and moves would increase slightly. The increase would depend on management actions in land, water, and resource monitoring as related to leasing activities. Because Alternative C provides less protection of surface resources than Alternative B, some of the areas adjacent to streams and lakes (Fish Creek drainage and deepwater lakes) identified as critical aquatic habitat would be available to leasing. Therefore, some of the additional camps and moves likely would be near these critical aquatic habitat areas.

b. Oil and Gas Exploration and Development Activities:

(1) Disturbance: Exploration and development activities within the planning area that may affect water resources under Alternative C would be similar to those in Alternative B, except that the number and frequency of these activities would increase slightly (Table IV.A.1.b-1). The increase would depend on the number of leases issued, the number of proposals for exploratory activity, and the locations of this activity. As noted previously (Sec. IV.D.3.a), some of the areas adjacent to streams and lakes identified as critical aquatic habitat would be available to leasing. Therefore, some of the additional exploration and development likely would be near these critical aquatic habitat areas. The likelihood of exploration and development activities occurring in an area that contains more water resources and critical aquatic habitat areas than Alternative B increases the risk of melting permafrost, disrupting drainage patterns, increasing erosion and sedimentation, and removing water from riverine pools and lakes.

(2) Spills and Spill Cleanup: Under alternative C, the potential number and extent of oil spills and cleanup would increase from those under Alternative B (Sec. IV.A.2). Alternative C, because it includes more of the critical lake and river habitat than Alteraative B, will have greater adverse effects on water resources as compared to Alternative B.

Conclusion—First Sale: The impacts of activities other than oil and gas exploration and development under Alternative C are expected to be similar to those under Alternative A (and similar to those under Alternative B). The potential long-term impacts (melting of permafrost and disrupting drainage patters) and short-term impacts (increasing erosion and sedimentation and removing water from riverine pools and lakes) of oil and gas exploration and development on the water resources in the planning area is expected to be greater for Alternative C than for Alternative B.

Multiple Sales: While the effects of oil and gas exploration and development from multiple lease sales may be up to several times greater than a single sale, impacts would not necessarily go up proportionally. Shared use of infrastructure such as airfields, roads, camps, and pipelines could significantly reduce the size of the impacted areas and adverse effects to the water resources.

Conclusion—Multiple Sales: Shared infrastructure could reduce the adverse effects to water resources of multiple lease sales, in that combined facilities require less water for construction, maintenance, and camp use than separate, independent facilities.

Effectiveness of Stipulations: The stipulations that are effective in minimizing potential effects of the ground-impacting-management actions on the water resources in the planning area for Alternative C are the same as for Alternative B.

4. Water Quality:

a. Activities Other Than Oil and Gas Exploration and Development: As discussed under Alternative A, ground-impacting management actions other than seismic operations and other oil and gas activities would not impact water quality.

b. Oil and Gas Exploration ana Development Activities:

(1) Exploration: Exploration activities within the planning area that may affect water quality under Alternative C are 2-D and 3-D seismic activity beyond that described under Alternative A, ice road construction, and pad construction, as found for Alternative B. Under Alternative C, total miles of seismic trails and resulting water degradation would be about twice that for Alternative A. That is, water quality could be degraded over a total of 1,800 acres.

For Alternative C, annual ice pad and road construction (45-370-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 17 to 130 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water pumped from a 2- to 4-acre source. Temporary up-slope impoundment of snowmelt waters could cover another 40 acres. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

(2) Development: Development activities within the planning area that may affect water quality under Alternative C are ice-road and pad construction and spills, as found for Alternative B.

Because of the continued need for ice roads, annual water use during development would be similar to that for exploration, with needed water for construction of 40 to 360 acres of ice-road withdrawn from 15- to 130-acres' worth of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water sources equivalent to an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring about 5 to 10 acres of lake for water supply for all field(s). Temporary upslope impoundment of snowmelt waters by ice roads could cover another 40 acres. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

The primary water-quality effect from construction and placement of gravel structures is related to up-slope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field air strip would cover about a 100-acre footprint per field, or a 100- to 200-acre total under Alternative C. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 200 to 400 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the field(s). These locations, however, would not be within the area deferred under Alternative C.

Spills are another impacting agent on water quality. A number of small crude spills averaging 4 bbl and smaller fuel spills averaging 0.7 bbl are projected to occur under Alternative C. Only about 8 percent of crude spills can be reasonably expected to reach tundra waters. For Alternative C, this calculation results in an estimate of 1 to 7 spills, each averaging 4 bbl, reaching tundra waters. Over the life of the fields, spills could affect the water quality of one to seven ponds or small lakes, making their waters toxic to sensitive species for about 7 years. These spill locations, however, would not be within the area deferred under Alternative C.

Conclusion—First Sale: Effects under Alternative C are similar to those in Alternative B for oil and gas activities, and similar to those for Alternative A for activities other than oil and gas. Annually, water quality over 2,000 acres could be affected by seismic trails, construction or placement of ice or gravel roads, and other structures. Oil spills could result in waters of up to seven ponds or small lakes remaining toxic to sensitive species for about 7 years.

Multiple Sales: During peak exploration, annual ice pad and road construction (45-370-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 19 to 170 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 4 to 6 acres of lake. Temporary up-slope impoundment of snowmelt waters could cover another 40 acres.

Because of the continued need for ice roads, annual water use during development for ice road construction would be similar to that for exploration, requiring extraction of water from 19 to 179 acres of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 15 acres of lake for water supply for all fields. Temporary up-slope impoundment of snowmelt waters by ice roads could cover another 40 acres.

The primary water-quality effect from construction and placement of gravel structures is related to up-slope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field air strip would cover about a 100-acre footprint per field, or a 100- to 300-acre total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in up-slope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 600 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields.

Over the life of development resulting from multiple sales, spills could degrade water quality of up to nine ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years.

Conclusion—Multiple Sales: Longer-term (decade-or-more) effects of multiple sales would be slightly greater than for a single sale. Oil spills could result in waters of up to nine ponds or small lakes remaining toxic to sensitive species for about 7 years.

Effectiveness of Stipulations: Effectiveness of stipulations is similar to that under Alternative B.

5. Air Quality:

a. Activities Other than Oil and Gas Exploration and Development: The ground-impacting-management activities that would affect air quality under Alternative C would be the same as those under Alternative A. The impacts of these activities would be the same as those under Alternative A.

b. Oil and Gas Exploration and Development Activities:

(1) Effects of Exploration: Exploration activities within the planning area that may affect air quality under Alternative C are drilling and pad construction, the same as for Alternative B. For Alternative C, the number of exploratory wells drilled per year would be the same as for Alternative B.

(2) Effects of Development: Development activities within the planning area that may effect air quality under Alternative C are drilling, facility and pipeline construction, and production, the same as Alternative B. Total number of wells drilled for Alternative C would be approximately one-quarter more that alternative B. Total emissions from these activities would be limited through permits obtained from the State of Alaska to less than the Clean Air Act standards.

Conclusion—First Sale: The impacts of oil and gas activities under Alternate C would be similar to those under Alternative B. Annually, air quality would be affected by drilling and construction activities at levels less than the PSD criteria. Effects of activities other than oil and gas are negligible, as in Alternative A.

Multiple Sales: The effects on air quality from multiple sales should result in air emissions that remain below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected.

Conclusion—Multiple Sales: Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.

Effectiveness of Stipulations: Current laws and regulations are assumed to be in place for the analysis of the IAP, and effects levels reflect this assumption.

6. Vegetation: Ground-impacting-management actions within the planning area that may affect vegetation under Alternative C include those analyzed under Alternative A and those resulting from oil exploration and development analyzed under Alternative B. The impacts of management actions described under Alternative A would be similar under Alternative C, except that the total areal extent of archaeological/paleontological excavations may increase to 4 acres per year and seismic survey activity would increase (see below).

a. Exploration: Impacts of exploratory drilling under Alternative C would be of the same type as under Alternative B, but there might be 4 to 15 wells drilled rather than 1 to 10. This scenario could result in the death of vegetation on the perimeters of oversummer ice pads of 0.1 to 0.3 acres of vegetation spread among 2 to 8 different sites. Construction of well collars would cause the destruction of vegetation on 0.02 to 0.09 acres.

The type of impacts of seismic exploration would remain the same as under Alternative B. It is assumed that the number of 2-D surveys would remain the same at one per winter, but that this frequency would continue for 15 years rather than 10 before decreasing to alternate winters. Because the tundra can recover from about 90 percent of these impacts in 9 years, it is expected that this change would result in little increase in area affected at any one point in time. It is also assumed that the number of 3-D surveys would increase from 0 to 2 over 5 years, to 1 to 3 over 10 years. This would result in 46,000 to 138,000 acres impacted by 3-D surveys.

b. Development: The impacts of oilfield development would be of the same type under Alternatives B and C. It is assumed the number of pump stations would remain 0 to 1, but the number of oilfields developed might increase from 0-1 to 1-2, with a proportional increase in the extent of area impacted. The gravel pads of these oil fields would bury 100 to 200 acres of vegetation. Dust effects would cover 36 to 72 acres and the effects of a changing moisture regime might affect 200 to 400 acres. Material sites would cause the destruction of 40 to 80 acres, with moisture-regime changes around them affecting another 20 to 40 acres. Pipeline miles would increase, causing impacts to vegetation to increase to 0.5 to 3.0 acres. The occurrence of spills would increase, affecting 0.5 to 3.0 acres.

Conclusion—First Sale: Impacts to vegetation from activities other than oil exploration and development under Alternative C would be the same as those under Alternative A, except that the effects of archaeological excavation might increase from 1 to 4 acres. The impacts of oil exploration and development would be of the same types as for Alternative B but greater in areal extent. The maximum acreage affected by 3-D seismic surveys would increase from 0 to 92,000 acres to 46,000 to 138,000 acres. The combined effect of development activities would cause the destruction of vegetation on 140 to 320 acres rather than 0 to 180 acres and the alteration in plant species composition of another 220 to 500 acres instead of 0 to 280 acres, for a total of effects over 360 to 820 acres rather than 0 to 460 acres. Finally, the occurrence of spills would increase, affecting 0.5 to 3.0 acres instead of 0.5 to 2.6 acres, but the probability of a blowout would remain low.

Multiple Sales: Additional lease sales under Alternative C would result in additional exploration activities and a total of 1 to 3 oilfields being developed. More acreage would be impacted by seismic surveys, but it would be over a longer period of time. Recovery from at least 90 percent of the impacts from the earliest surveys is expected to be complete before additional seismic operations would commence as a result of multiple sales. The total number of exploratory wells is assumed to increase from 2-6 to 6-18, and delineation wells from 2-9 to 2-15, for a total of 8 to 33 wells drilled from ice pads. Vegetation destruction from well collars would increase to affect 0.05 to 0.2 acres, and vegetation death around ice-pad perimeters would increase to 0.2 to 0.8 acres. Tundra would recover from the latter in 1 to a few years.

With the assumption of 1 to 3 oilfields developed, the vegetation that might be destroyed by burial under gravel fill would increase to 100 to 300 acres. The area of vegetation around oilfield gravel pads that would undergo change from dust or moisture regime impacts would be 200 to 600 acres. The impacts of developing material sites would increase correspondingly to the number of oilfields. This would mean the destruction of vegetation on 40 to 120 acres and effects of moisture-regime changes on 20 to 60 acres. It is assumed that the number of pump stations would remain at 0 to 1, resulting in the burial of 0 to 40 acres and dust- or moisture-regime changes on an additional 0 to 60 acres. The number of pipeline miles would increase somewhat under multiple sales, with a total of 15 to 120 mi, resulting in the destruction or alteration of a total of 0.5 to 3.6 acres. The incidence of oil spills also would increase, affecting 0.8 to 4.2 acres of vegetation.

Conclusion—Multiple Sales: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time. Exploration activities also would result in 0.05 to 0.2 acres of permanent vegetation destruction around well collars and alteration of 0.2 to 0.8 acres around ice pads. The activities of oilfield development that would impact vegetation include construction of gravel pads, roads, and airstrips for each oilfield; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on 140 to 460 acres and the alteration in plant species composition of another 220 to 720 acres, for a total of effects over 360 to 1,160 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills would affect 0.8 to 4.2 acres of vegetation within the planning area. Recovery from spills would take a few years to two decades. The probability of a blowout would remain low.

Effectiveness of Stipulations: Effectiveness of stipulations would remain the same as under Alternative B: there are no stipulations beyond existing management practices that could reduce the above impacts to vegetation.

7. Fish:

a. Activities Other Than Oil and Gas Exploration and Development: Actions associated with Alternative C that may affect fish include the establishment of large work camps at pre-existing airstrips; small scientific excavations for paleontological, geologic, and soils-related information; the sport harvest of fish by workers, and those associated with fuel spills at fuel-storage sites. The establishment of work camps, scientific excavations, and the sport harvest of fish are not expected to have a measurable adverse effect on arctic fish populations. Fuel spills at fuel-storage sites may adversely affect arctic fish populations.

b. Oil and Gas Exploration and Development Activities: Alternative C also involves several management actions associated with oil and gas development. These include seismic surveys; the construction of gravel drill pads, roads, airstrips, and pipelines; and oil spills (drill pad, pipeline, and supply barge). The individual effects of these actions and the chemical agents associated with them have been discussed in previous Beaufort Sea EIS's (e.g., USDOI, MMS, 1996a), which are herein incorporated by reference. The remainder of this analysis focuses on differences in the amount of exposure arctic fish are likely to have to each of these actions in Alternative C as compared to Alternative B. More of the planning area is exposed to oil and gas development in Alternative C (73%) than in Alternative B (44%). This additional area supports a greater number and diversity of fish than the fish-bearing waters of Alternative B. These differences increase the probable number of oil- and gas-related activities, the probability of their affecting arctic fish populations (roughly 2-3 times higher), and the probable overall effect of Alternative C on fish over that of Alternative B.

(1) Effects of Disturbance:

(a) Effects from Seismic Surveys: Arctic fish are likely to be adversely affected by seismic surveys located above overwintering areas. Likely effects would include avoidance behavior and short-term added stress but also could result in the death of some of the more sensitive lifestages (e.g., juveniles). However, the effect on most overwintering fish is expected to consist of only short-term, sublethal effects. While Alternative C is likely to involve more seismic surveys than Alternative A and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Hence, seismic surveys associated with Alternative C are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations). While Alternative C is likely to involve more fuel spills than Alternative A, the amount of fuel entering fish habitat is not expected to increase significantly. Hence, fuel spills associated with Alternative C are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations).

(b) Effects from Construction: Construction-related activities that may affect arctic fish include the construction of drill pads, roads, airstrips, pipelines; and possibly gravel extraction. The individual effects of these activities for Alternative C are expected to be the same as discussed for Alternative B and are summarized below. However, the likelihood of the above construction-related activities occurring and affecting fish habitat is roughly two to three times greater in Alternative C than in Alternative B. Depending on the specific level and location of implementation, this could result in a corresponding increase in the overall effect of these activities in Alternative C over that of Alternative B.

Construction during exploration would involve freshwater withdrawals for the construction of ice drill pads, roads, and airstrips. Ice roads or airstrips constructed through overwintering areas <10 ft deep would freeze to the bottom and form a barrier to water circulation, resulting in reduced levels of dissolved oxygen. This could have lethal effects on the fish affected by the barrier. The construction of ice roads and airstrips in non-overwintering areas is expected to have no measurable effect on arctic fish. Freshwater withdrawals may adversely affect fish, if the water is taken from areas where they are overwintering. Under-ice withdrawals from areas having water and dissolved-oxygen levels barely to moderately sufficient to support to overwintering fish would be likely to kill many of the fish overwintering there. The recovery of affected fish populations would be expected in 5 to 10 years. However, withdrawals from freshwater sources that do not support resident fish populations, or from areas having sufficient under-ice reserves of water and dissolved oxygen, are not likely to adversely affect overwintering fish.

Construction during production would involve the construction of gravel drill pads, roads, and airstrips. The effects of gravel construction and gravel extraction activities in high density areas are expected to be spawning failure and mortality for many of the fish affected (an estimated 10-year recovery). No measurable effects on arctic fish populations are expected in low-density areas. The effects of pipeline trenching through overwintering or spawning habitat are likely to be spawning failure and/or mortality of many fish, and a 5 to 10-year recovery period. Trenching that avoids these habitats is not expected to adversely affect fish. The difference in the estimated number of pipeline miles (up to 75 mi for Alternative B and up to 90 mi for Alternative C) is not expected to make a measurable difference in effects on arctic fish in Alternative C.

(2) Effects of Spills: The individual effects of oil on fish for Alternative C are the same as discussed for Alternatives A and B. As discussed therein, lethal effects on fish due to a petroleum-related spill are seldom observed outside the laboratory environment. Sublethal effects are more likely and include changes in growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources; and consumption of contaminated prey. The specific effect of oil on fish generally depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). The oil-spill assessment estimates that the amount of oil spilled during the life of the field would be 328 bbl for Alternative C and 280 bbl for Alternative B. However, neither this difference nor the fact that oil- and gas-related activities are estimated to be two to three times more likely to affect fish in Alternative C are expected to alter the overall effect of oil spills on arctic fish. Hence, oil spills associated with Alternative C are expected to have the same overall effect on arctic fish as discussed for Alternative B. Oil spills are expected to lethally or sublethally affect a small number of fish in the planning area over the production life of the field. Recovery from each spill affecting fish is expected within 3 years.

Conclusion—First Sale: The effect of fuel spills on arctic fish populations in Alternative C are expected to be similar to Alternative A. The individual effects of seismic surveys, construction related activities, and oil spills are expected to be similar to that of Alternative B. However, the likelihood of their occurrence is estimated to be roughly two to three times higher for Alternative C than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of these activities on arctic fish populations in Alternative C over that of Alternative B.

Multiple Sales: The actions most likely to affect arctic fish for the first lease sale have been discussed herein and include seismic surveys, construction related activities, fuel spills, and oil spills. While additional northeastern NPR-A lease sales would involve more seismic surveys than the first sale, and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Seismic surveys associated with multiple sales in Alternative C are expected to have the same overall effect on fish as discussed for the first sale (i.e., no measurable effect on arctic fish populations). For additional northeastern NPR-A lease sales that may occur in the future, the number of production pads and pipeline miles have been estimated (Table IV.A.1.b-7). That table estimates that there would be about twice the number of gravel pads as the first sale (Table IV.A.1.b-6). On the basis of this estimate, gravel pads for multiple sales are likely to have about twice the effect on arctic fish as the first sale. Because there is little difference in the estimated number of pipeline miles for multiple sales (up to 105) and the first sale (up to 90), they are expected to have a similar effect as discussed for the first sale. It is estimated that up to 460 bbl of crude oil would be spilled for multiple sales, or about 1.4 times that of the first sale (estimated at up to 328 bbl). On the basis of this estimate, crude oil spills for multiple sales are expected to have a slightly greater effect on arctic fish than the first sale. However, if there were not enough time between sales to allow for full recovery, or if the level of activity of the selected alternatives were significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations is likely to be greater than estimated herein for multiple sales.

Conclusion—Multiple Sales: Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish as the first sale. Gravel pads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.

Effectiveness of Stipulations: The stipulations having the most beneficial effect on arctic fish are the same as discussed for Alternative B. However, due to the increased level of potential oil and gas activity associated with Alternative C over that of Alternative B, the absence of these stipulations may increase adverse effects on arctic fish populations.

8. Birds: This section discusses potentially adverse effects of ground- impacting-management actions on nonendangered birds within the planning area under Alternative C. Such actions potentially may result in disturbance factors, habitat alteration or loss, and fuel or oil spills. Effects on birds exposed to such factors would be similar to those discussed under Alternative B.

a. Activities Other than Oil and Gas Exploration and Development: Management actions other than oil and gas exploration and development under Alternative C, and their potential effects, differ from Alternative A approximately as discussed under Alternative B, differing from B primarily in that the Colville River would be recommended for inclusion as a "scenic" river in the WSR System rather than a "wild" river in Alternative B. These differ as follows: (1) mineral leases are allowed in the river corridor; (2) new roads/trails/bridges could be constructed in the river corridor and be more conspicuous, and prohibitions on motorized travel may be less likely; and (3) major public facilities are allowed within the river corridor. These specifications could enhance raptor and passerine habitat protection and potentially decrease the level of noise and visual disturbance of nesting birds in comparison to Alternative A but is expected to allow greater levels of habitat degradation and disturbance than Alternative B. Without stipulations to assure avoidance of important habitat areas, raptor nesting success and passerine populations in developed areas of the river corridor could decline under this classification in comparison to Alternative B.

b. Oil and Gas Exploration and Development Activities: Oil and gas leasing would be allowed on most (approximately [illegible] of the planning area (Fig. II.C.1-3; Table IV.A-1), except in the Goose Molting Habitat and Teshekpuk Lake Caribou Habitat LUEA's. Exploration and development activity under Alternative C will be slightly greater than under Alternative B, with 3 to 5 additional exploratory and delineation wells drilled (4-15 v. 1-10), 1 additional production pad, and 10-15 additional miles of pipeline (Tables IV.A.1.b-5-7). Additional drilling would prolong the period during which disturbance and habitat unavailability would occur 1-2 winter seasons. An additional production pad would displace any nesting birds from 60 to 110 acres for the duration of production, and additional pipeline would result in a negligible increase in disturbance during monitoring flights. The additional acreage leased could result in potential exposure of additional areas of concentration for some waterbird species. None of these differences are expected to result in significantly greater effects on bird populations than those discussed for Alternative B.

Conclusion: Effects of actions other than oil and gas activity under Alternative C are expected to be essentially the same as for Alternative B, except in the Colville River corridor, where increased activity would result in greater effects. Effects of oil and gas activity are not expected to be significantly different than discussed for Alternative B.

Multiple Sales: If multiple sales occur in the area available for leasing under Alternative C, intensive construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Approximately two-times the number of exploration and delineation wells may be drilled (8-33 v. 4-15), and the number of fields developed (1-3 v. 1-2) and production pads (1-5 v. 1-2) are expected to double, with multiple sales (Tables IV.A.1.b-4-7). Pipeline mileage (10-90 mi) is expected to increase to 10 to 105 mi. Surface, air, and foot traffic are expected to increase somewhat in some areas if oilfield facilities associated with multiple sales are grouped in high-resource-interest areas; if these coincide with high-bird- concentration areas, greater numbers of individuals are expected to be displaced and more species involved than with a single sale. Such increases may cause some changes in planning area population levels. Effects from disturbance and habitat alteration or loss on birds is expected to increase in the southern three-quarters of the planning area with multiple sales under Alternative C.

The estimated number of onshore oil spills ≥1 bbl is expected to increase from 4 to 21 under the first sale to 5 to 28 with multiple sales (Tables IV.A.2-3a-3b); this slight increase in spills is expected to cause a slightly greater loss of individuals and number of species involved. An increase from 35 to 190 small refined-oil spills under the first sale (average size of 29 gal) to 51 to 269 with multiple sales is expected over the production life of the planning area (Tables IV.A.2-6a-6b). Although generally these small, chronic spills are contained and cleaned up on pads and roads, a slight increase in their occurrence is expected to have a similar slight effect on birds and their habitats as the first sale under Alternative C. Habitat contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect populations significantly. These spills are expected to result in the loss of only small numbers of birds. Recovery of cumulative lost productivity and recruitment is expected within 1 year.

Conclusion—Multiple Sales: Displacement of birds from disturbance and habitat alteration is expected to increase over the southern three-quarters of the planning area under Alternative C with multiple sales, but not significantly affect planning area populations. Increases in oil and refined oil spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect is expected to increase somewhat from that discussed for the first sale.

Effectiveness of Stipulations: Effectiveness of stipulations under Alternative C is expected to be essentially the same as described under Alternatives A and B.

9. Mammals:

a. Terrestrial Mammals: Among the terrestrial-mammal populations that could be affected under Alternative C are caribou of the Teshekpuk Lake Herd (TLH) and the Central Arctic Herd (CAH). Moose, muskoxen, grizzly bears, wolves, wolverines, and arctic foxes may be locally affected by planning-area activities.

(1) Activities Other than Oil and Gas Exploration and Development: The level of activities such as resource inventories, aerial surveys, and research camps is expected to increase somewhat under Alternative C compared to Alternative A, but the level of effect is expected to be about the same.

(2) Oil and Gas Exploration and Development Activities: Under Alternative C, one to two oilfields are assumed to be discovered and developed. Primary effects on terrestrial mammals would come from motor-vehicle traffic within the oilfield(s). Other effects could come from foot traffic near facilities and camps, from aircraft traffic, from seismic operations, from small, chronic crude-oil and fuel spills contaminating tundra, stream, and coastal habitats, and from habitat alteration associated with gravel mining and construction. (See Alternative B, Sec. IV.C.9.a, for a discussion of general effects of disturbance and spills.) The planning area can be divided into thirds—northern (including Teshekpuk Lake and the Beaufort coast), middle (the area generally west and southwest of Nuiqsut), and southern. Under Alternative C, the middle and southern areas would be available for leasing and development (Fig. II.C.1-3).

(a) Effects of Disturbance: If a field is developed in the middle planning area west and southwest of Nuiqsut, production pads, pipelines, within-field roads, and other facilities (housing, airfield, processing plant) would be located far to the south of the TLH calving area. Little or no effect on caribou movements within the calving range is expected, and no TLH calving is expected to be displaced. Some TLH migration movements may be adversely affected by air and surface traffic along pipelines and roads within the oilfield(s).

If a field is developed in the southern planning area, some members of the CAH, WAH, and TLH would encounter the field during their fall migration route and within a portion of their winter range. However, neither the pipeline to TAP nor facilities within the oilfield would be expected to significantly affect the movement of caribou or alter their distribution or abundance.

A pipeline from the oilfield(s) would connect to the TAPS through facilities at the Alpine and Kuparuk River fields. The pipeline would be constructed during winter using ice roads, so that no permanent road would be associated with the pipeline. During construction, air traffic would include several flights per day, which could temporarily disturb some of the caribou of the TLH and CAH and other terrestrial mammals within about 1.2 mi (2 km) of the pipeline. Disturbance effects on caribou and other terrestrial mammals are expected to be short term, interference with mammal movements would be temporary (probably a few minutes to less than a few days), and the mammals eventually would cross the pipeline area. Additionally, disturbance reactions would diminish after construction, and flights would decrease to about one or two per day at most. The abundance and overall distribution of terrestrial mammals are not expected to be affected by pipeline construction or operation.

(b) **Effects of Spills**: For general information on the effects of oil spills on terrestrial mammals, please see the discussion under Alternative B (Sec. IV.C.9.a). Chronic crude-oil and fuel spills from onshore activities and possible marine transportation probably would result in the loss of small numbers of terrestrial mammals. Under Alternative C, approximately 4 to 21 small (<1 bbl) crude-oil spills (averaging 4 bbl) and 35 to 190 small refined-oil spills (averaging 29 gal) are assumed to occur onshore over the production life of the planning area (Tables IV.A.2-2 and 2-5). These small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B.

Conclusion—First Sale: For activities other than oil and gas, the effects of Alternative C are expected to be similar to those of Alternative A. For oil and gas activities, effects of Alternative C are expected to be somewhat greater than those of Alternative B. Increased habitat alteration would include the development of one or two oilfields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic, but these disturbances are not expected to affect caribou migrations and overall distribution. Near the oilfields, surface, air, and foot traffic are expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase somewhat and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.

Multiple Sales: If several lease sales occur under Alternative C, considerably more exploration activity is expected to occur in the southern half of the planning area with the number of exploration wells drilled increasing from 2 to 6 under the first sale to 6 to 18 under multiple sales. The amount of development also is expected to increase, with the number of oil fields increasing from one to two under the first sale to one to three under multiple sales, the number of production pads increasing from one to two under the first sale to one to five under multiple sales, and pipeline miles increasing from 10 to 90 under the first sale to 10 to 105 under multiple sales. The level of effects on caribou and other terrestrial mammals, including noise, disturbance, and habitat alteration, is expected to increase somewhat, primarily in the southern half of the planning area. Surface, air, and foot traffic near the oilfields is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations.

Under Alternative C multiple sales, the number of small crude-oil spills (<1 bbl) is expected to increase from an estimated 4 to 21 under the first sale to 5 to 228 under multiple sales (average size of 4 bbl), and a total of 35 to 190 small fuel-oil spills under the first sale (average size of 29 gallons) to 51 to 269 under multiple sales are estimated to occur onshore over the production life of the planning area (Tables IV.A.2-3a, 3b, 6a, and 6b). These small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as those under Alternative B with one sale, but with a loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations.

Conclusion—Multiple Sales: Effects of oil and gas activities under multiple sales are expected to be somewhat greater than those of Alternative C under the first sale. Surface, air, and foot traffic near the oilfields is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase somewhat and result in the loss of small numbers

402

of terrestrial mammals, with recovery expected within 1 year.

Effectiveness of Stipulations: Effectiveness of stipulations under Alternative C are expected to be essentially the same as described under Alternative A. No long-term oil and gas surface occupancy would be allowed within the Pik Dunes LUEA, an area available to leasing under Alternative C and used in summer by some TLH caribou for insect relief. This stipulation could reduce potential disturbance of some TLH caribou.

b. Marine Mammals:

(1) Activities Other than Oil and Gas Exploration and Development: Effects under Alternative C would be similar to those for Alternative A—local and short term, with no significant adverse effects to the populations as a whole.

(2) Oil and Gas Exploration and Development Activities: Effects under Alternative C are expected to be essentially the same as those for Alternative B. Some potential noise and disturbance effects could occur along the coast, primarily in the Colville River Delta-inner Harrison Bay area, and these effects are expected to be local and short term (generally <1 year). Small onshore crude- and fuel-oil spills associated with Alternative C are not expected to reach the marine environment and affect marine mammals.

Conclusion—First Sale: For marine mammals under Alternative C, the effects of activities other than oil and gas are expected to be similar to those for Alternative A; the effects of oil and gas activities are expected to be essentially the same as for Alternative B.

Multiple Sales: If several lease sales occur under Alternative C considerably more exploration activity is expected to occur in the southern half of the planning area with the number of exploration wells drilled increasing from 2 to 6 under one sale to 6 to 18 under multiple sales. The amount of development is expected to increase also with the number of oil fields increasing from 1 to 2 under one sale to 1 to 3 under multiple sales, the number of production pads increasing from 1 to 2 under one sale to 1 to 5 under multiple sales and miles of pipeline increasing from 10 to 90 under one sale to 10 to 105 under multiple sales. However, most oil and gas activities under Alternative C are expected to occur onshore and far to the south of the coast. Only a small increase in potential noise and disturbance effects on marine mammals is expected along the coast, primarily in the Colville River delta-inner Harrison Bay area, and these effects are expected to be local and short term (generally <1 year).

Conclusion—Multiple Sales: Effect of oil and gas activities under Alternative C with multiple sales is expected to be essentially the same as for Alternative B with multiple sales.

Effectiveness of Stipulations: Effectiveness of stipulations is expected to be the same as under Alternative A.

10. Endangered and Threatened Species:

a. Activities Other Than Oil and Gas Exploration and Development: Activities other than oil and gas associated with the management plan still would occur under this alternative. Ground-impacting management actions within the planning area that may affect bowhead whales and spectacled and Steller's eiders under Alternative C include aerial surveys (including that of wildlife) and ground activities such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall. A description of these activities and potential effects on these species is discussed in Section IV.B.10 (Alternative A) and summarized here. The potential effects from these activities are expected to be essentially the same as described in Alternative A. A detailed discussion of all management actions is found in Section II.

Bowhead whales are not likely to be affected by any activities associated with the management plan. Some eiders may be affected by activities associated with aircraft traffic and hazardous- and solid-material removal and remediation. Under this alternative there will be an increase in the number of aircraft flights for point-to-point flights, aerial wildlife surveys, and other aerial surveys. Under Alternative C, point-to-point flights increase from occasional to regular but not daily. Aerial wildlife surveys in late June and early July increase from 14 days to 21 days and other aerial surveys increase from occasional flights to several 1- to 2-week periods (Table II.D.3). Summertime aircraft flights over sensitive areas for eiders may affect nesting females and their broods. Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake (spectacled eider LUEA, Fig. II.B.3) may be overflown by aircraft (both helicopters and fixed-wing) on a regular basis during the summer months and may experience temporary, nonlethal effects lasting probably less than an hour. Due to the relatively low density of eiders in the area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

BLANK PAGE

b. Oil and Gas Exploration and Development Activities: Under Alternative C, oil and gas leasing would occur in the planning area, although the northern portion of the planning area extending just to the south of Teshekpuk Lake would be unavailable to oil and gas leasing. No leasing would occur in the spectacled eider LUEA. In addition, leasing would not occur in most of the higher density eider-nesting areas outside of the spectacled eider LUEA. This analysis is based on a development scenario presented in Section IV.A.1.b of this EIS. The reader is referred to these sections for a discussion of resource-recovery rates and quantities, timing of infrastructure development, platform emplacement, wells drilled, and resource production timeframes and other information relevant to the development of the resources of the IAP. The BLM proposes to conduct multiple oil and gas lease sales within the planning area. Multiple sales are discussed later in this section. Under Alternative C, oil resources for the initial sale are expected to be in the 75- to 410-MMbbl range with from one to two fields, which is considered a reasonable range of resource development and activity level for the portion of the planning area open to leasing (Table IV.A.1.b.5). Information on the number of exploration, delineation, and production wells anticipated to be drilled and pipeline miles can be found in Table IV.A.1.b-5. Resources at the low end of the resource range (75-MMbbl) are not economically viable as stand-alone fields. Differences in effects on the species as a result of noise and disturbance over this range of scenarios are expected to be minor. Differences in effects on the species as a result of an oil spill during the development production scenario (75-410-MMbbl-resource range) also are expected to be minor.

For Alternative C, it is estimated that from 11 to 61 spills <1 bbl would occur, and from 4 to 21 spills >1 bbl would occur over the assumed production life of the planning area (Table IV.A.2-3a). For the purposes of analysis, this EIS assumes an average spill size of 4.0 bbl and that the estimated number of crude-oil spills over the assumed production life of the planning area would range from 15 to 82 spills (Table IV.A.2-2a). Information pertaining to oil spills can be found in Section IV.A.2.

(1) Effects on the Bowhead Whale: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills associated with oil and gas activities or other activities associated with the management plan are expected to be essentially the same under this alternative as under Alternative B.

(2) Effects on the Spectacled and Steller's Eiders: The potential effects on spectacled and Steller's eiders from discharges, noise and disturbance, and oil spills associated with oil and gas activities are expected to be essentially the same under this alternative as under Alternative B.

Conclusion–First Sale: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills are expected to be essentially the same under this alternative as under Alternative B. The potential effects on spectacled and Steller's eiders from discharges, noise and disturbance, and oil spills associated with oil and gas activities are expected to be essentially the same under this alternative as under Alternative B. However, there may be an increase in potential effects on eiders from activities other than oil and gas activities associated with the management plan due to an increase in summertime aircraft flights over sensitive areas that may affect nesting females and their broods. Under this alternative there will be an increase in the number of aircraft flights for aerial wildlife surveys and other aerial surveys. Aerial wildlife surveys in late June and early July increase from 14 days to 21 days. Spectacled and Steller's eiders breeding, nesting, or rearing young in the coastal areas may be overflown by support aircraft and may experience temporary, nonlethal effects lasting probably less than an hour. In the central portion of the planning area, Steller's eiders occasionally may be overflown by support aircraft and may experience temporary, nonlethal effects lasting probably less than an hour. It is unlikely that the primary Alaskan nesting area, located south and southeast of Barrow, would be affected much by these activities; so significant disturbance of nesting or broodrearing eiders is not expected to occur. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative C increases from a range of 75 to 410 MMbbl in one to two oilfields (Table A2-5) to a range of 110 to 580 MMbbl in one to three oilfields (Table IV.A.1.b-6). Resources at the low end of the resource range (110 MMbbl) are not economically viable as stand-alone fields. The number of exploration wells increase from a maximum of 6 to 18, delineation wells increase from a maximum of 9 to 15, and production wells increase from a maximum of 122 on 2 pads to 174 on 5 pads. Pipeline miles increase from 90 to 105 mi (Tables IV.A.1.b-5 and 7). Multiple sales would occur over a longer period of time and, depending on frequency of sales and results from exploratory drilling operations, possibly increase the timeframe for oil and gas activities in the planning area by a couple of decades.

For Alternative C, it is estimated that the number of spills <1 bbl would increase from a range of 11 to 61 spills to a range of 17 to 87 spills, and the number of spills >1 bbl would increase from a range of 4 to 21 spills to a range of 5 to 28 spills over the assumed production life of the planning area (Tables IV.A.2-3a and 3b). The estimated number of crude oil spills over the assumed production life of the planning area would increase from a range of 15 to 82 spills to a range of 22 to 115 spills (Tables IV.A.2-2a and 2b). Information pertaining to oil spills can be found in Section IV.A.2.

Conclusion--Multiple Sales: The effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the first sale.

Effectiveness of Stipulations: The effectiveness of stipulations for noise and disturbance from oil and gas activities is the same as for Alternative B, and from activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, the same as for Alternative A.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: Alternative C would generate recreation-field employment by 30, 1-week long float-trip parties per year (Table II.H.3.b), equal to one person for 8 months each year.

b. Oil and Gas Exploration and Development Activities: Increased revenues and employment are the most significant economic effects that would be generated by Alternative C. Increased property-tax revenues and new employment would be created with the construction, operation, and servicing of facilities associated with oil and gas activities. These facilities are described in Table IV.A.1-1 and are summarized as follows. For exploration, 2 to 6 exploration and 2 to 9 delineation wells would be drilled between 2000 and 2008; for development 23 to 122 production and service wells would be drilled, 1 to 2 production pads constructed, and 10 to 90 mi of onshore pipeline installed between 2006 and 2017. The number of workers needed to operate the infrastructure is determined by the scale of the infrastructure and not by the amount of oil produced. A wide range of production volume can be handled by a given level of infrastructure. Once the infrastructure is in place, the number of workers needed to operate it does not depend on the amount of product flowing through it. Effects include employment generated by seismic surveys during exploration. State property-tax revenues are in proportion to the value of onshore facilities. State royalty income and State severance tax are in proportion to production. Peak yearly production is estimated at 8 to 41 MMbbl. (For complete descriptions of resources and associated activity, see Sec. IV.A.1.b)

(1) North Slope Borough Revenues and Expenditures: Exploration, development, and production are projected to generate increases in property taxes above the levels without Alternative C activities starting in 2000 and averaging about 1 to 2 percent each year through the production period, or about $2 to $4 million.

(2) North Slope Borough Employment: The gains from Alternative C in direct employment would include jobs in petroleum exploration, development, and production and jobs in related activities (Table IV.D.11-1). Direct employment is anticipated to peak in the range of 1,100 to 1,500 jobs during the development phase, and decline to a level in the range of 500 to 800 during production from 2018 to 2028.

Total NSB resident employment is anticipated to increase in the range of 36 to 44 jobs in the peak of development and level off to 17 to 27 during production after 2017 (Table IV.D.11-1). The peak increase in resident employment is about 2 to 3 percent greater with Alternative C than without during development, and about 1 to 2 percent greater during production. The increase in employment opportunities may partially offset declines in other job opportunities and delay expected outmigration. Increases in resident population will correspond to increases in employment (Table IV.D.11-2).

No workers will be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

(3) Effects of Subsistence Disruptions on the NSB Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents primarily through the direct loss of subsistence resources. See Section IV.D.13 for effects on subsistence-harvest patterns.

(4) State Revenues: State revenues will increase as a result of Alternative C. Property-tax revenues to the State will be approximately 25 percent of the revenues to the NSB, or $0.5 to $1 million annually. State royalty income will be in proportion to production, or approximately $0.25 million for each 1 MMbbl of oil produced and flowing through the TAPS, or $1 to $5 million annually. State severance tax will be half that amount, or $0.5 to $2.5 million annually.

(5) Southcentral Employment: Workers in the enclave centered at Prudhoe Bay probably would commute to permanent residences in Southcentral Alaska, Fairbanks, and outside the State. However, for the purpose of this

Table IV.D.11-1
Summary of Employment Forecasts, Alternative C

	IAP Employment in Enclave			NSB Resident Employment		
	Without IAP Activity	With IAP Activity		Without IAP Activity	*Increase* with IAP Activity	
Year		$18/bbl	$30/bbl		$18/bbl	$30/bbl
1999	0	0	0	1,865	0	0
2000	0	99	99	1,825	2	2
2001	0	179	259	1,794	8	9
2002	0	99	259	1,767	10	17
2003	0	39	359	1,746	8	20
2004	0	59	139	1,730	9	21
2005	0	269	349	1,716	9	16
2006	0	1,185	1,332	1,701	36	43
2007	0	638	844	1,685	39	44
2008	0	625	760	1,662	15	18
2009	0	607	1,578	1,614	13	32
2010	0	476	933	1,565	9	19
2011	0	476	889	1,513	12	23
2012	0	486	978	1,470	14	29
2013	0	486	956	1,431	15	30
2014	0	486	911	1,393	16	31
2015	0	506	911	1,357	17	31
2016	0	506	911	1,350	17	31
2017	0	506	911	1,330	17	31
2018	0	506	800	1,310	17	27
2019	0	500	800	1,290	17	27
2020	0	506	800	1,290	17	27
2021	0	506	800	1,310	17	27
2022	0	506	800	1,330	17	27
2023	0	506	800	1,350	17	27
2024	0	506	800	1,370	17	27
2025	0	506	800	1,390	17	27
2026	0	506	800	1,410	17	27
2027	0	506	800	1,430	17	27
2028	0	506	800	1,450	17	27

Sources: Resident employment 1999–2015, Rural Alaska Model, North Slope Borough, 1996; IAP employment and resident employment 2016–2028, Manpower Model and MMS.

Table IV.D.11-2
Summary of NSB Population Forecasts, Alternative C

Year	Resident Population No IAP Activity	Increase in Resident Population IAP Activity $18/bbl	Increase in Resident Population IAP Activity $30/bbl	Year	Resident Population No IAP Activity	Increase in Resident Population IAP Activity $18/bbl	Increase in Resident Population IAP Activity $30/bbl
1999	5,067	0	0	**2014**	6,582	48	93
2000	6,134	6	6	**2015**	6,423	51	93
2001	6,213	24	27	**2016**	6,300	51	93
2002	6,301	30	51	**2017**	6,200	51	93
2003	6,391	24	60	**2018**	6,100	51	81
2004	6,488	27	63	**2019**	6,000	51	81
2005	6,684	27	48	**2020**	6,000	51	81
2006	6,695	109	129	**2021**	6,100	51	81
2007	6,820	117	132	**2022**	6,200	51	81
2008	6,918	45	54	**2023**	6,300	51	81
2009	7,011	39	96	**2024**	6,400	51	81
2010	7,050	27	57	**2025**	6,500	51	81
2011	7,004	36	66	**2026**	6,600	51	81
2012	6,891	42	87	**2027**	6,700	51	81
2013	6,743	45	90	**2028**	6,800	51	81

Sources: For years 1999–2015, Rural Alaska Model, North Slope Borough, 1996. For 2016–2028, MMS.

analysis, it is assumed all of the enclave workers (Table IV.D.11-1) commute to Southcentral and have permanent residences there except during peak construction years.

Population in Southcentral generated directly and indirectly by enclave workers during production will be in the range of 7,500 to 12,000, or 2 to 3.2 percent of the Southcentral population. In the 7-year period of the exploration and development phases, the population direcily and indirectly associated with Alternative C would rise to the level sustained during production.

Conclusion-First Sale: For activity other than oil and gas, Alternative C would generate approximately 50 jobs for 4½ months associated with seismic surveys and recreation-field employment equivalent to one person working 8 months per year. Activities other than oil and gas would have no effect; production in Alternative C is projected to generate increases above the levels of Alternative B as follows: NSB property taxes, 1 percent ($1-$2 million); direct oil-industry employment, 200 to 500 during production (5x this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 1 percent; and annual revenues to the State of $0.25 to $0.5 million, and $0.5 million from property tax, royalty income, and severance tax, respectively.

Multiple Sales: The effect of multiple sale for Alternative C is project to be approximately two times that of the first sale for Alternative C.

Conclusion—Multiple Sales: The effect of multiple sale for Alternative C is project to be approximately two times that of the first sale for Alternative C.

Effectiveness of Stipulations: Mitigating measures would not change potential economic effects.

12. Cultural Resources:

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Cultural resources (the physical remains resulting from the activities of historic or prehistoric humans) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative C, the management-action impacts generally would be the same as under Alternative A, except the intensity of the actions would increase due to potential oil and gas exploration.

(2) Oil and Gas Exploration and Development Activities:

(a) Effects of Disturbance from Exploration: The types of oil and gas exploration activities that would occur under Alternative C would be the same as those that would occur under Alternative B. However, the level or intensity of these exploration activities would increase under Alternative C. The number of exploration/delineation wells drilled would increase from 10 to 15, and as many as 3 might be drilled during a single winter season. This would increase the area of potential impact by 50 percent over Alternative B.

(b) Effects of Exploration Spills: These effects would be the same as those under Alternative B, except the possibility of impacts would be increased by 50 percent.

(c) Effects of Disturbance from Development: The types of oil and gas development activities that would occur under Alternative C are the same as those that would occur under Alternative B. However, the level or intensity of these development activities would increase under Alternative C. While the number of production pads and pump stations is expected to remain the same as in Alternative B, crude-oil pipeline miles would increase by 15 for a total of 90 mi under Alternative C. This would increase slightly the area of potential impact over Alternative B.

(d) Effects of Development Spills: These effects would be the same as those under Alternative B, although the possibility of spills would be slightly increased.

Conclusion—First Sale: Under Alternative C, impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature but may be somewhat increased in magnitude over Alternative A. Under Alternative C, most of the impacts to cultural resources would result from oil and gas exploration and development, although there is a possibility that no such activities would impact cultural resources sites. When compared with Alternative B, the potential for impact to cultural resources is somewhat greater under Alternative C.

Multiple Sales: The potential impacts to cultural resources under Alternative C could increase by as much as 20 percent compared to Alternative B.

Conclusion—Multiple Sales: Under Alternative C, potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B.

but the probability of impacts occurring would increase. Under alternative C, the potential impacts to cultural resources form oil and gas exploration and development would increase by roughly 20 percent compared to Alternative B.

Effectiveness of Stipulations: These effectiveness of stipulations would be the same as under Alternative B.

13. Subsistence-Harvest Patterns: This section analyzes the impacts of ground-management actions and oil and gas leasing on the subsistence-harvest patterns of communities in or near the planning area. This analysis is organized by types of effects and discusses effects on subsistence-harvest patterns on each affected community as a result of disturbance and oil spills. Analytical descriptions of affected resources and species, a more in-depth discussion of the parameters for subsistence-harvest patterns impact analysis as well as indigenous Inupiat knowledge concerning effects are described in more detail in the discussion for Alternative B (Sec. IV.C.13).

Under Alternative C, maximum protection to certain high-value resources would be emphasized by making unavailable to oil and gas leasing important waterfowl and caribou habitat (3.39 million acres would be available and 1.26 million acres would be unavailable to oil and gas leasing). The Teshekpuk Lake Watershed, Goose Molting Habitat, Spectacled Eider Nesting Concentration, and Teshekpuk Lake Caribou Habitat LUEA's would be made unavailable to oil and gas leasing. The Fish Habitat LUEA would be available to oil and gas leasing, with the exception of Teshekpuk Lake. The Colville River would be recommended as a "scenic" river in the WSR System and managed as such. Also, Kuukpik Corporation entitlement lands would be made available to oil and gas leasing.

Portions of the Colville River would be made available to oil and gas leasing. Raptor, passerine, and moose areas on the Colville River, the Pik Dunes, Ikpikpuk Paleontological Sites, and recreation and scenic areas also would be made available to oil and gas leasing but subject to restrictions for siting pipelines and industrial structures.

a. Ground-Impacting-Management Actions:

(1) Activities other than Oil and Gas Exploration and Development: Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil exploration activities—seismic activity and exploration drilling—would occur in winter (early December to mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Under Alternative C, one to two fields with a resource range of 75 to 410 MMbbl are estimated. For exploration, two to six wells would be drilled. For development, 2 to 9 delineation and from 23 to 122 production and service wells would be drilled, as well as from 10 to 90 mi of pipeline constructed. At $18 per barrel, Alternative C as a stand alone field would not be commercially viable; nevertheless, such a field would be developed if it were close to existing infrastructure.

(a) Effects of Disturbance: Sources for disturbance from exploration and development would be essentially the same as those discussed for Alternative B (Sec. IV.C.13, Subsistence).

(b) Effects of Spills: Under Alternative C, one to two fields with a resource range of 75 to 410 MMbbl are estimated. Oil-spill-occurrence estimates over the assumed production life of the planning area range from 15 to 82 crude-oil spills, with a volume range from 60 to 328 bbl (average spill size equals 4 bbl). For spills >1 bbl, the range is from 4 to 21 spills. For TAPS spills resulting from NPR-A production, the number of spills ranges from 1 to 6, with a volume ranging from 1 to 7 bbl. Oil-spill-occurrence estimate for TAPS tanker spills resulting from NPR-A resources is a 64- to 92-percent chance of 0 spills (with an average spill size of 30,000 gal) occurring. Thirty-five to 190 refined-oil spills (diesel fuel, aviation fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil) with an estimated volume ranging from 24 to 131 bbl (average spill size equals 29 gal) are estimated. Historically, by volume, diesel fuels account for 75 percent of the refined oil spills. All NPR-A scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. Adequate data are not available to estimate a chance of such an occurrence. Records indicate four pipeline leaks, with the largest discharge being 125 bbl. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would substantially affect the subsistence harvest (Sec. IV.C.13, Subsistence).

b. Effects on Subsistence Species:

(1) Terrestrial Mammals:

(a) Effects from Disturbance: For oil and gas activities, effects of Alternative C on terrestrial mammals are expected to be somewhat greater than those of Alternative B. Increased habitat alteration would include the development of one or two oilfields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic, but these disturbances are not expected to affect caribou migrations and overall distribution. Surface, air, and foot traffic near the oilfields is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations (Secs. IV.C.9 and IV.D.9).

(b) Effects of Spills: The potential for an oil spill occurring and contacting areas used by Barrow, Atqasuk, and Nuiqsut subsistence-caribou hunters is very low, considering the data that indicate primarily chronic, small spills that most often are contained on pad. If a spill occurred off the pad, the impact of oil spills would be very local and would tend to contaminate tundra in the immediate vicinity of the spill source. The number of small, chronic crude-oil and fuel spills is expected to increase somewhat over Alternative B and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year (Secs. IV.C.9 and IV.D.9).

(2) Fish:

(a) Effects of Disturbance: The individual effects of actions related to oil and gas development on arctic fish resources are the same for Alternative C as for Alternative B. However, the likelihood of their occurrence is estimated to be roughly two to three times higher for Alternative C than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of drill pad, road, airstrip, and pipeline construction on arctic fish populations in Alternative C over that of Alternative B (Secs. IV.C.7 and IV.E.7). Effects on fish resources from seismic and construction disturbance are expected to increase under this alternative with chronic, local, short-term impacts on the subsistence fisheries of Barrow and Nuiqsut; Atqasuk's subsistence fishery does not quite reach the western edge of the planning area.

(b) Effects of Spills: Oil spills associated with Alternative C are expected to have the same overall effect on arctic fish populations as those discussed for Alternative B (Secs. IV.C.7 and IV.D.7).

(3) Birds:

(a) Effects of Disturbance: Effects of seismic surveys, exploratory drilling, construction in winter, and development well drilling year-round, as well as spill cleanup activities, are expected to be similar to Alternative B, i.e., localized and range from brief to several months in duration, requiring no more than 1 year for recovery. More intense activity such as routine overflights of lakes and increased boat or foot traffic along rivers is expected to require >1 year for recovery (Secs. IV.C.8 and IV.D.8).

(b) Effects of Spills: The potential for an oil spill occurring and contacting areas used by Barrow, Atqasuk, and Nuiqsut subsistence-waterfowl hunters is very low considering the data that indicate primarily chronic, small spills that most often are contained on pad, but oil or fuel spills entering lakes with large staging waterfowl populations are expected to require >1 year for recovery (Secs. IV.C.8 and IV.D.8).

(4) Bowhead Whales:

(a) Effects of Disturbance: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills essentially are expected to be the same under this alternative as under Alternative B. The potential effects on spectacled and Steller's eiders from discharges and noise and disturbance associated with oil and gas activities essentially are expected to be the same under this alternative as under Alternative B (Secs. IV.C.10 and IV.D.10).

(b) Effects of Spills: Under Alternative C, there would be no leasing in the northern portion of the planning area, thereby eliminating the potential for a fuel-oil spill from a supply barge transporting equipment to coastal staging areas. Small onshore spills are unlikely to reach the marine environment. Oil-spill effects on bowhead whales under Alternative C would be the same as Alternative B (Secs. IV.C.10 and IV.D.10).

(5) Other Marine Mammals:

(a) Effects of Disturbance: For marine mammals under Alternative C, the effects of oil and gas activities essentially are expected to be the same as for Alternative B (Secs. IV.C.9 and IV.D.9).

(b) Effects of Spills: For marine mammals under Alternative C, the effects of oil and gas activities essentially are expected to be the same as for Alternative B (Secs. IV.C.9 and IV.D.9).

409

c. Effects on Communities: Effects on Barrow, Atqasuk, and Nuiqsut from oil-industry-development disturbance are discussed in detail in Section IV.B.10 of the Beaufort Sea Sale 170 FEIS (USDOI, MMS, In prep.). See previous discussions in this section of effects on the primary subsistence species: caribou (and other terrestrial mammals), fish, birds, bowhead whales, and other marine mammals. Effects assessments from these sections are summarized below; for a synthesis of traditional knowledge (where available), see effects discussion for Subsistence under Alternative B (Sec.IV.C.13).

(1) Barrow, Atqasuk, and Nuiqsut—Effects from Disturbance and Spills: Under Alternative C, effects similar to those for Alternative B are expected, i.e., short-term and localized impacts from disturbance and oil spills to terrestrial mammals (other than caribou), birds, bowhead whales, and other marine mammals. Increases in disturbance and oil spills are expected to have corresponding increases in effects to fish and caribou, but overall populations would not be impacted and, in the case of caribou, impacts on migration and distribution patterns are not expected. Effects to resources harvested by subsistence hunters from these three communities would have no apparent effect on overall subsistence harvests. Under Alternative C, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal, the same effects as for Alternative B, although fish resources would not be subject to as much protection under this alternative. Impacts would be further minimized by not leasing in important caribou and waterfowl areas under this alternative and from protection afforded by other management actions (see Effectiveness of Stipulations below).

Under this alternative, BLM would determine that the Federal portion of the Colville River to be eligible as a "scenic" river in the WSR System. If Congress eventually added the river to the system, BLM would develop a management plan to identify its management practices for the river. One issue that would be addressed in the plan would be whether motorized travel would be allowed on the river. A decision not to allow motorized travel could reduce the use of the river for subsistence.

(2) Other Communities—Effects from Disturbance and Spills: Other communities within or adjacent to the NPR-A are the Chukchi Sea villages of Point Lay and Wainwright to the west and the inland community of Anaktuvuk Pass to the south and east. Subsistence-harvest areas for these communities are not within or adjacent to the planning area, although recent research indicates that movement by the Teshekpuk Lake Caribou Herd does bring the herd into the traditional subsistence-harvest areas of the communities of Wainwright and Point Lay. Historically, Anaktuvuk Pass caribou hunters have ranged to the southerly boundary of the planning area, and movement by the Teshekpuk Lake caribou herd would bring it into the harvest area of Anaktuvuk Pass subsistence hunters as well, although they primarily hunt the Western Arctic Herd (and, to a lesser extent, the Central Arctic Herd). Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake and Central Arctic herds would have no apparent effect on the subsistence-caribou harvest for these three communities, the same level of effects as for Alternative B.

Conclusion—First Sale: Overall effects associated with Alternative C subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase somewhat over Alternative B. Periodic impacts to subsistence resources are expected but no resource would become unavailable, undesirable for use, or experience overall population reductions, essentially the same level of effect as Alternative B.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative C increases from a range of 75 to 410 MMbbl in one to two oilfields to a range of 110 to 580 MMbbl in one to three oilfields. Resources at the low end of the resource range (110 MMbbl) are not economically viable as stand-alone fields; nevertheless, such a field would be developed if it were close to existing infrastructure. The number of exploration wells increase from 6 to 18, delineation wells increase from 9 to 15, and production wells increase from 122 on 2 drill pads to 174 on 5 drill pads. Pipeline miles increase from 90 to 105 mi. Multiple sales would occur over a longer period of time and, depending on frequency of sales, the timeframe for oil and gas activities in the planning area would extend to at least 2 decades.

For Alternative C, it is estimated that the number of spills <1 bbl would increase from a range of 11 to 61 spills to a range of 17 to 87 spills, and the number of spills >1 bbl would increase from a range of 4 to 21 spills to a range of 5 to 28 spills over the assumed production life of the planning area. The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 15 to 82 spills to a range of 22 to 115 spills.

Effects of oil and gas activities under multiple sales are expected to be somewhat greater than those of Alternative C with the first sale. Surface, air, and foot traffic near the oilfields is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase somewhat and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. For arctic fish populations, each additional sale is expected to have similar effects on arctic fish as those described for Alternative C. However, if there are increased levels of activity associated with future lease sales and/or insufficient recovery time between sales, greater adverse effects than those described for Alternative C are likely to occur. An increase in effects to bird populations from increased noise disturbance could be expected with multiple sales, with corresponding increases in disturbance and local displacement, but recovery in these instances is still expected to require no more than 1 year. Oil spills entering larger lakes with larger numbers of molting or broodrearing geese and other species may result in losses in the hundreds, requiring several breeding seasons for recovery. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described above for the first sale. The effects of oil and gas activities on marine mammals under Alternative C with multiple sales essentially is expected to be the same as for Alternative B with multiple sales.

Conclusion—Multiple Sales: Effects from multiple sales to terrestrial mammals are expected to increase but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost due to the increase of small chronic crude oil and fuel spills, but populations are expected to recover within 1 year. Arctic fish populations would experience effects similar to Alternative C as high-density fish areas are unavailable to leasing, but increases are expected if sale intervals are not spaced sufficiently to provide population recovery. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. Bowhead whales, as in Alternative C, are expected to experience short-term, nonlethal effects. Effects to marine mammals would be short term and local with no adverse effects to populations.

Given that resource estimates and development scenarios project an increase in resources and large increases in the number of drill pads and pipeline miles, logic would assume increased effects to potentially affected resources, except for the fact that these effects would be spread over 2 decades. The biological analyses expect slight increases in effects with little overall effects to resource populations; therefore, effects associated with multiple sales on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and (especially) Nuiqsut as a result of impacts from disturbance and oil spills are expected to make no subsistence resource unavailable, undesirable for use, or experience overall population reductions.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.D.7, Fish Resources, IV.D.8, Birds, IV.D.9, Mammals, and IV.D.10, Endangered and Threatened Species. The effectiveness of stipulations for protecting subsistence practices is the same as for Alternative B, most important of which being a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on NPR-A.

14. Sociocultural Systems: This discussion is concerned with those communities that could be impacted by ground management actions and oil and gas leasing in the planning area. These communities are Barrow, Atqasuk, and Nuiqsut. Under Alternative C, maximum protection to certain high-value resources would be emphasized by making unavailable to oil and gas leasing important waterfowl and caribou habitat (3.39 million acres would be available and 1.26 million acres would be unavailable to oil and gas leasing). The Teshekpuk Lake Watershed, Goose Molting Habitat, Spectacled Eider Nesting Concentration, and Teshekpuk Lake Caribou Habitat LUEA's would be made unavailable to oil and gas leasing. The Fish Habitat LUEA would be available to oil and gas leasing, with the exception of Teshekpuk Lake. The Colville River would be recommended as a "scenic" river in the Wild and Scenic Rivers System and managed as such. Also, Kuukpik Corporation entitlement lands would be made available to oil and gas leasing.

Portions of the Colville River would be made available to oil and gas leasing. Raptor, passerine, and moose areas on the Colville River, the Pik Dunes, Ikpikpuk Paleontological Sites, and recreation and scenic areas also would be made available to oil and gas leasing but subject to restrictions for siting pipelines and industrial structures.

The primary aspects of the sociocultural systems covered in this analysis are (1) social organization and (2) cultural values, as described in Section III.C.3. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level, predominantly by industrial activities, increased population, increased employment, and effects on subsistence-harvest patterns associated with the sale. For a more in-depth discussion of the parameters for sociocultural effects analysis, see the discussion for Alternative B (Sec. IV.C.13).

a. Ground-Impacting Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. For a more in-depth discussion of non oil and gas exploration and development activities, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil exploration activities – seismic activity and exploration drilling – would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled, and moved inland the following winter. Under Alternative C, one to two fields with a resource range of 75 to 410 MMbbl are estimated. Two to 6 exploration wells would be drilled. For development, 2 to 9 delineation and from 23 to 122 production and service wells would be drilled, as well as from 10 to 90 mi of pipeline constructed. At $18 per barrel, Alternative C would not be commercially viable.

(a) Disturbance from Exploration and Development: Sources for disturbance from exploration and development essentially would be the same as those discussed for Alternative B (Sec. IV.C.13, Sociocultural Systems).

(b) Spills and Spill Cleanup: See Section IV.C.13, Subsistence for a discussion of Alternative C oil spills.

b. Population and Employment: Under Alternative C, oil and gas leasing in the planning area is projected to affect the population of the North Slope Borough through two types of effects on regional employment: (1) more petroleum industry-related jobs as a consequence of NPR-A exploration and development and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (Sec. IV.B.11.). Employment projections as a consequence of NPR-A activities are provided in Section IV.C.11. Throughout the development and production phase, total petroleum-related employment would peak in 2006 at 1,185 to 1,332 jobs. Resident employment as a result of NPR-A activities would peak at 36 to 44 in the year 2006. Most workers are expected to permanently reside outside of the North Slope. The NPR-A oil and gas activities are projected to increase resident employment 2 to 3 percent during the development phase and 1 to 2 percent during the production phase above the declining existing-condition projections (Tables IV.D.11-1 and IV.D.11-2). The NPR-A development under Alternative C is projected to increase the NSB population at above the existing-condition level.

c. Subsistence-Harvest Patterns: Effects could be expected on subsistence-harvest patterns in the planning area as a result of disturbance to Barrow, Atqasuk, and Nuiqsut's subsistence harvests due to seismic disturbance, aircraft noise, supply vessel traffic, onshore-construction, and oil spills (see discussion for Alternative C, Sec. IV.D.14).

d. Effects on Barrow, Atqasuk, and Nuiqsut: This section analyzes effects of industrial activities, population and employment changes, and subsistence-harvest-pattern impacts on North Slope social organization, cultural values, and other issues. This discussion focuses on the North Slope as a whole and with a discussion for each community.

(1) Social Organization: The social organization of communities that might be affected by oil and gas activities in the planning area includes typical features of Inupiat culture: kinship networks that organize much of a community's subsistence-harvest, consumption, and sharing activities; informally derived systems of respect and authority; strong extended families (although not always living in the same household); stratification between families focused on success in the subsistence harvest; and access to subsistence technology (Sec. III.C.2). However, activities generated by oil and gas activities in the planning area are not likely to bring about effects to these features in the communities in question (see discussion for Alternative B, in Sec. IV.C.13).

(2) Cultural Values: Cultural values and orientations (as described in Sec. III.C.2) can be affected by changes in the population, social organization and demographic conditions, economy, and alterations of the subsistence cycle. Of these, the only changes that could be expected to occur would be in Nuiqsut's social organization and the subsistence cycle in Barrow, Atqasuk and Nuiqsut (see discussion for Alternative B, Secs. IV.C.13 and IV.C.13; Sec. IV.D.14).

Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd and Central Arctic Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters would have no apparent effect on subsistence harvests. Under Alternative C, it is expected that subsistence hunter concerns about access to resources and resource contamination would be minimal. No leasing in important caribou and waterfowl areas under this alternative and

412

protection afforded by other management actions (see Effectiveness of Stipulations below) would further minimize impacts.

Overall effects associated with Alternative C subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase from those under Alternative B, but subsistence resources would be only periodically impacted with no apparent effect on subsistence harvests. Short-term disruptions of subsistence-harvest activities could cause periodic disruption to institutions and sociocultural systems but likely would not displace existing institutions.

(3) Social Health: Effects on sociocultural systems often are evidenced in rising rates of mental illness, substance abuse, and violence. This has proven true for Alaskan Natives who have been faced since the 1950's with increasing acculturative pressures. The rates of these occurrences far exceed those of other American populations such as Alaskan non-Natives, American Natives, and other American minority groups (see discussion for Alternative B, Sec. IV.C.13). Although there may be additional reasons for differences in social problems in local communities, it is clear that the proximity to industrial enclaves enables residents easier access to drugs and alcohol, thereby affecting the social health of the community—a situation that could intensify in Nuiqsut as a result of NPR-A oil and gas activity. Any effects on social health would have ramifications in the social organization, but NSB Native communities have, in fact, proven quite resilient to such effects by local voter insistence on these communities being "dry," and by the NSB's continued support of Inupiat cultural values and its strong commitment to health, social service, and other assistance programs.

Nuiqsut is the most likely community in the region to experience additional sale-related effects in social health and well-being. These effects on social health could have direct consequences on the sociocultural system but would not have a tendency toward displacement of existing institutions above the displacement that already has occurred with the current level of development. Effects on the institutions and sociocultural systems in Barrow and Atqasuk would be *periodic* but not displace existing institutions.

Conclusion—First Sale: Effects from management actions and oil and gas activities in the planning area under Alternative C are unlikely to disrupt sociocultural systems. Disturbance effects would be short term and would not be expected to disrupt or displace institutions and sociocultural systems, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources. Overall effects under Alternative C to the sociocultural systems of the communities of Barrow, Atqasuk, and Nuiqsut would be negligible, as in Alternative B.

Multiple Sales: If several lease sales occur under Alternative C, considerably more exploration activity is expected to occur in the planning area, and the levels of effects due to noise, disturbance, and habitat alteration are expected to increase. Given that resource estimates and development scenarios project an increase in resources and a large increase in the number of drill pads and pipeline miles, logic would assume a large increase in the effects to potentially affected subsistence resources, except for the fact that these effects would be spread over 2 decades. The critical factor would be the timing between sales—a longer interval would allow more recovery for subsistence resources from aircraft, vehicular, and construction disturbance and for subsistence practices from increased access conflicts; lack of an interval might not allow for sufficient recovery. In any case, the cumulative effect clearly would be an increased development "footprint" and consequent increased habitat loss to resources and use loss to hunters. This could affect subsistence harvests in the communities of Barrow, Atqasuk, and (especially) Nuiqsut and could alter caribou distributions sufficiently to make subsistence-hunter access more difficult.

Conclusion—Multiple Sales: Effects from management actions and oil and gas activities in the planning area for multiple sales under Alternative C could disrupt sociocultural systems for periods up to 1 year, but impacts would not be expected to displace institutions and sociocultural systems, community activities, or traditional practices for harvesting, sharing, and processing subsistence resources, the same level of effect anticipated for multiple sales under Alternative B.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.D.7, Fish Resources, IV.D.8, Birds, IV.D.9, Mammals, and IV.D.10, Endangered and Threatened Species. The effectiveness of stipulations for protecting subsistence practices and sociocultural systems is the same as for Alternative B, most important of which being a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on NPR-A.

15. Coastal Zone Management: Under Alternative C, approximately 3.4 million acres would be available for leasing, including coastal areas near the Colville River Delta and in southern Harrison Bay. Surface resource protections for important, high-value waterfowl and caribou habitat exclude about 1.2 million acres from possible oil and gas leasing. These excluded areas include the Goose Molting Habitat, Spectacled Eider Nesting Concentrations, and Teshekpuk Lake Caribou Habitat LUEA's. Portions of some other LUEA's would be unavailable for leasing, because they overlap these LUEA's. Areas that would be made available to oil and gas leasing are subject to restrictions for siting pipelines and industrial structures. The Colville River in the planning area would be recommended and managed as a "scenic" river in the WSR System.

Federal lands within the NPR-A are excluded from the coastal zone; however, all uses and activities on Federal lands either occurring within the coastal zone or that may reasonably be expected to affect the coastal area and its resources must be consistent to the maximum extent practicable with enforceable standards of the ACMP, including State standards in 6 AAC 80 and enforceable policies of local district programs. The enforceable policies of the NSB CMP have been incorporated within the zoning ordinance in Section 19.70.050. The primary goal of the NSB's LMR's and zoning ordinances is to protect the subsistence lifestyle of the Borough's largely Inupiat population while also encouraging and managing economic development.

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions described under Alternative C would be the same as for Alternative A, except that under Alternative C, the level of activities would increase due to potential oil and gas exploration. The number and frequency of camps and overland moves would increase but are unknown at this time.

b. Oil and Gas Exploration and Development Activities: The level of activities other than oil and gas would be similar to or somewhat greater for Alternative C than for Alternative A (Table IV.A.1.a-1). Under Alternative C, oil-exploration activities, including seismic activity and exploration drilling, would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Under this alternative, one to two fields with a resource range of 75 to 410 MMbbl are estimated. For exploration, two to six wells would be drilled. For development, 2 to 9 delineation and from 23 to 122 production and service wells would be drilled and from 10 to 90 mi of pipeline constructed. At $18 per barrel, Alternative C as a stand-alone field would not be commercially viable; nevertheless, such a field would be developed if it were close to existing infrastructure.

Effects of Exploration and Development on the Alaska CMP: For oil and gas activities, effects of disturbance from Alternative C to terrestrial mammals are expected to be slightly greater than under Alternative B. For Alternative C, the effects of potential conflicts with the State's and Borough's coastal management programs are expected to be about the same as for Alternative B, because no leasing in important caribou and waterfowl areas would occur under Alternative C. Increased habitat alteration would include the development of one or two oilfields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic, but such disturbances are not expected to affect caribou migrations and overall distribution. Some terrestrial mammals may be displaced, but there would not be a significant effect to Arctic Slope populations (Secs. IV.C.9 and IV.D.9). Effects to the community of Nuiqsut are similar to Alternative B, but access is greater, because the area around Nuiqsut is more immediately available to leasing. Should development occur near Nuiqsut, effects are expected to be short term with localized impacts from disturbance and oil spills to terrestrial mammals (other than caribou), birds, bowhead whales, and other marine mammals. Corresponding increases in effects to fish and caribou would occur as a result of human disturbance and oil spills but would not impact overall populations, migration, and distribution patterns of caribou. Effects to resources harvested by Barrow subsistence hunters would have no apparent effect on their overall harvest. Under Alternative C, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal, the same effects as for Alternative B, although fish resources would not be subject to as much protection under this alternative. Impacts would be further minimized by not leasing in important caribou and waterfowl areas under this alternative and from protection afforded by other management actions, including special stipulations (see Section II and Effectiveness of Stipulations).

Potential conflict between Alternative C proposed activities and Statewide standards and NSB district policies may arise but are not expected, in conjunction with the NSB CMP 2.4.5.2(h) (NSBMC 19.70.050.K.8) that relates to both subsistence and cultural resource areas. This policy requires that development be located, designed, and maintained so as not to interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence-use areas. Also, conflict with district policies may arise in the potential for adverse effects to subsistence resources. NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) relates to "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems." Potential conflicts with these standards will be minimized by stipulations developed for this lease sale. Potential conflicts with the State's subsistence standards (6 AAC 80.120) are not anticipated.

Conclusion—First Sale: For Alternative C, the effects of potential conflicts with the State's and Borough's coastal management programs are expected to be about the same as for Alternative B, because no leasing in important caribou and waterfowl areas would occur under Alterative C. Problems could occur with specific Statewide standards and NSB CMP policies related to user conflicts between development activities and access to subsistence resources. Conflicts are possible with the NSB CMP policy related to adverse effects on subsistence resources. These effects could occur as a result of spilled oil contacting subsistence resources and habitats and as a result of the activities associated with oil-spill cleanup. No conflicts are anticipated during exploration.

Multiple Sales: If multiple sales occur in the area for leasing under Alternative C, intensive construction activity could last 15 to 30 years. Increases in wells drilled and number of fields developed and producing may double with multiple sales. Conflicts with State and Borough policies are essentially the same as Alternative B.

Conclusion—Multiple Sales: Displacement of birds from disturbance and habitat alternation is expected with multiple sales, but should not significantly affect coastal plain bird populations. Effects from multiple sales to terrestrial mammals are expected to increase, but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude-oil and fuel spills, but populations are expected to recover within 1 year (Sec. IV.C.9). Arctic fish populations would experience effects from seismic surveys and pipelines similar to those discussed for the first sale (i.e., no measurable effect on arctic fish populations). However, fuel and oil spills are likely to have a greater effect on fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated for multiple sale. Increased disturbance and displacement effects and increased oil-spills risks are expected to increase for birds in the southern half of the planning area under Alternative B with multiple sales, but not significantly affect coastal plain populations. Bowhead whales exposed to noise-producing activities such as marine-vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Effects of multiple sales and increased potential for noise-producing activities and oil spills to marine mammals would be short term and local with no adverse effects to populations. Multiple sales may cause potential conflicts with the subsistence, habitat, air- and water-quality, and transportation standards of the ACMP; however, each oil and gas lease operating plan will be reviewed for consistency on a case-by-case basis.

Effectiveness of Stipulations: The effectiveness of stipulations for protecting subsistence practices under Alternative C is the same as Alternative B, particularly with establishment of a Subsistence Advisory Panel to monitor subsistence issues and concerns. Stipulations to protect terrestrial mammals would be in place, the same as under alternative B. Other protections are provided, since no long-term oil and gas surface occupancy would be allowed within the Pik Dunes LUEA. This area is open to leasing under Alternative C and used in the summer by some TLH caribou for insect relief. Stipulations would be in place to protect arctic fish, and are the same as discussed under Alternative B. Stipulations would be in place to protect disturbance of birds from ground transport and other activities, including oil and gas, and essential habitat protections. For example, Stipulations 20b through [illegible] will minimize and seasonally restrict vehicle use and seismic activity and provide precautions in Goose Molting and Colville River LUEAs for geese, raptor, and passerine, as well as seasonal restrictions on drilling and major construction (see Sec. IV.C.8 for a detailed description of additional stipulations developed to provide protections to birds and waterfowl). Management actions in Alternative C also provide protections to high-value resources.

16. Recreation and Visual Resources:

a. Activities Other than Oil and Gas Exploration and Development:

Disturbance: Activities other than oil and gas exploration and development under Alternative C are the same as under Alternative A. However, certain of these activities would increase as a result of or in support of oil and gas development. For example, field activities associated with archaeological site clearances such as camps, excavations, and aircraft activity all likely would increase. Impacts would be minimal and short term in nature, as described under Alternative A, but the total area impacted could increase to 2,000 acres (from 1,500 acres under Alterative A). This is the same as under Alternative B.

Although the amount of supplies and material transported by winter overland moves may increase under this alternative, these moves generally follow the same route. Therefore, neither the length nor number of green trails is expected to noticeably increase from Alternative A.

b. Oil and Gas Exploration and Development Activities:

(1) **Exploration:** The types of oil and gas exploration activities that would occur under Alternative C are similar to those under Alternative B. However, the level of some of these exploration activities would increase compared to Alternative B—additional seismic-survey operations are expected, the number of exploration/delineation wells drilled at any one time would increase from 1 to 2, and the total number of these wells would increase from 10 to 15. Consequently, short-term impacts from ongoing seismic activity could increase from 500 acres affected under Alternative A and 1,000 acres under Alternative B to 1,500 acres affected under Alternative C. The area that could be impacted during drilling operations would increase from approximately 8,000 acres to 16,000 acres (winter only). Accumulating summer-season visual impacts from the greening of ice pads, roads, and airstrips would increase from about 500 acres to 750 acres. Several hundred miles of lineal green trails also would be visible from the air as a result of seismic operations; the numbers of miles visible would increase from Alaternative B in direct relationship to increased seismic operations.

(2) **Development:** The types of oil and gas development activities that would occur under Alternative C are similar to those under Alternative B. While the number of production pads and pump stations is anticipated to be the same, the number of miles of pipeline is expected to increase from 75 mi (under Alternative B) to 90 mi under Alternative C. Consequently under this alternative, there would be a long-term loss of scenic quality, solitude, naturalness, or primitive unconfined recreation over an area of approximately 82,000 acres (i.e., [8,000 acres/pad x 2 pads] + [8,000 acres/pump station x 1 pump station] + [640 acres/mi x 90 mi of pipeline]). This is about 10,000 acres more than under Alternative B.

Effects of Spills: The effects of spills would be the same as analyzed for Alternative B.

Effects to Wild and Scenic River Values: Under this alternative, resources on Federal lands and waters on and along the Colville River will receive the protection of a "scenic river" as afforded by the WSR Act (Appendix G). As such, certain development not allowed in the designated river corridor under Alternative B would be allowed under this alternative. However, management priorities for a scenic river still require that outstandingly remarkable river values be protected. Therefore, while developments such as pipelines and roads would be allowed to cross or access the river, these developments would be designed to minimize or avoid impacts to outstandingly remarkable river values. For example, a pipeline could cross the river, but it might be buried rather than aboveground to protect scenic values. Roads could access the river, but through design and perhaps location restrictions, the impacts to identified outstandingly remarkable values would be minimized. Under this alternative, the potential impacts to outstandingly remarkable values on Federal lands and waters is greater than under Alternative B, but nevertheless minimal. State and private lands and resources on and along the designated portion of the Colville River would not be under BLM management or protection.

Conclusion—First Sale: As compared to Alternative A, there would be an increase of approximately 500 acres to 2,000 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. As compared to Alternative B, short-term impacts from ongoing oil and gas exploration activities would increase from approximately 9,000 acres impacted to approximately 17,500 acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would increase to about 750 acres, a 250-acre increase from Alternative B. Seismic operations would result in several hundred miles of green trails with likely increases over Alternative B directly corresponding to increases is seismic operations.

Oil and gas development would result in the long-term loss of scenic quality, solitude, naturalness, or primitive unconfined recreation over an area of approximately 82,000 acres (or 1.8% of the planning area) for the life of production fields and pipelines. This is 10,000 acres more than under Alternative B.

Multiple Sales: The types of impacts resulting from additional sales will be the same as described above for the first sale. Short-term impacts such as green trails and disturbance resulting from noise, aircraft, and other ongoing activities would not accumulate. Impacts from permanent facilities such as roads, pipelines, gravel pads, and pits are long term and will accumulate to the extent such facilities are necessary to support additional exploration and production. It is anticipated that such facilities will increase about 45 percent over that needed for the first sale and affect a total of approximately 107,000 acres.

Conclusion—Multiple Sales: Long-term impacts will accumulate and increase about 45 percent above those of the first sale, ultimately affecting approximately 170,000 acres or about 2.3 percent of the planning area.

Effectiveness of Stipulations: The upper Colville River upstream from about Umiat would be designated Visual Management Class II under this alternative. As such, no permanent visible structures would be allowed in this important recreation and scenic Class A area. The Colville River from abut Umiat to Ocean Point, a scenic Class B area and also an important recreation area, would be managed as a Visual Management Class III area. Under Class III guidelines, construction may be visible but should not dominate the landscape. Mitigation required to meet the standards established by these management classes should prevent any significant long-term impacts to visual/recreation values in these two highly scenic and important recreation areas.

Under this alternative, the Kuukpik LUEA would be managed as a Visual Management Class IV area rather than Class III area, as under Alternative B. Under Class IV guidelines, construction may dominate the landscape in terms of scale. This would result in less aggressive efforts to mitigate visual impacts. An aboveground pipeline through this area may exceed Class III standards.

The remaining planning area is designated Visual Management Class IV, the same as under Alternative B.

As under other alternatives, impacts to recreation values from exploratory oil and gas activities and from overland moves are significantly reduced by restricting these activities to winter months. Few recreationists visit the area during winter months.

BLANK PAGE

E. ALTERNATIVE D:

E. ALTERNATIVE D: Alternative D would include BLM's management actions described for Alternative A and a proposal making approximately 4,150,000 acres of the Northeast NPR-A Planning Area available to oil and gas leasing. This alternative focuses protection on certain high-value resources by making important waterfowl habitat unavailable to oil and gas leasing; the status of the LUEA's for oil and gas leasing under Alternative D is shown in Table IV.E-1. Seismic activities would be permitted throughout the planning area. Applicable stipulations identified in Section II will be applied to this alternative. In addition, the alternative includes (1) recommending the Colville River be included as a "recreational" river in the WSR System, (2) establishing a Bird Conservation Area that would incorporate part of the Colville River valley, (3) creating a Special Area designated by the Secretary of the Interior along the Ikpikpuk River to protect paleontological resources, and (4) adding the Pik Dunes LUEA to the Teshekpuk Lake Special Area.

The types of activities that might impact resources include those noted for Alternative A and those additional activities associated with oil and gas exploration and development as noted for Alternative B. The level of activities other than oil and gas would be similar to or slightly greater for Alternative D than for Alternative A (Table IV.A.1.a-1). The economically recoverable oil resources for the first oil and gas lease sale are estimated to range from 185 to 825 MMbbl (Table IV.A.1.b-4). The oil resources estimated for Alternative D are greater than those estimated for Alternative B (Table (IV.A.1.b-4), and thus the levels of activities associated with Alternative D also are estimated to be greater than they are for Alternative B. These activities include drilling 9 to 28 exploration and delineation wells, constructing one to six production pads, drilling 55 to 248 production and service wells, and constructing 80 to 105 mi of pipeline (Table IV.A.1.b-5). If the area available for oil and gas leasing under Alternative B results in multiple sales, 370 to 1,650 MMbbl of oil are estimated to be recovered (Table IV.A.1.b-6). The types of activities associated with multiple sales would be similar to those that might occur as the result of the first sale. The level of activities for multiple sales is shown in Table IV.A.1.b-7.

1. Soils:

The types of activities that may affect soils under Alternative D include those analyzed under Alternatives A and B.

a. Activities Other than Oil and Gas Exploration and Development:

The effects of

Table IV.E-1
Land Use Emphasis Areas Status for Oil and Gas Leasing Under Alternative D[1]

Land Use Emphasis Area	Fig. No. II.B.	Oil and Gas Leasing Status
Teshekpuk Lake Watershed	1	The northern part of the LUEA north of Teshekpuk Lake would be unavailable for leasing. The remainder of the watershed would be available for leasing
Goose Molting Habitat	2	Unavailable
Spectacled Eider Nesting Concentrations	3	Spectacled eider nesting concentrations north of Teshekpuk Lake would be unavailable for leasing. Spectacled eider nesting concentrations east of the Ikpikpuk River would be available for leasing
Teshekpuk Lake Caribou Habitat	4	The northern part of the LUEA north of Teshekpuk Lake would be unavailable for leasing. The remainder of the Teshekpuk Lake Caribou Habitat would be available for leasing
Fish Habitat	5	Available
Colville River Raptor, Passerine, and Moose Area	6	Available
Umiat Recreation Site	8	Available
Scenic Areas	9	Available
Pik Dunes	10	Available
Ikpikpuk Paleontological Sites	11	Available
Kuukpik Corporation Entitlement	13	Available
Potential Colville Wild and Scenic River	14	Available

[1] Section II.

management actions described under Alternative D are similar to those under Alternative A, except there may be an increase in excavations (Sec. IV.E.6).

b. Oil and Gas Exploration and Development Activities: Under Alternative D, the impacts from exploration drilling and development activities would be the same as under Alternative B, except there would be an increase in the estimated level of activities. These activities could result in an estimated permanent loss of about 142 to 564 acres of soils (based on loss of vegetation, as noted in Sec. IV.E.6). Impacts to soils from spills and spill cleanup are similar in area as those with impacts to vegetation (Sec. IV.E.6).

Conclusion—First Sale: Estimated areas of impacts and losses of soils from all activities are similar to those areas discussed under vegetation (Sec. IV.E.6).

Multiple Sales. Additional lease sales under Alternative D would result in additional exploration and development activities. The area of impacted soils is closely related to that of the disturbed vegetation (see Vegetation, Sec. IV.E.6, for acreage details).

Conclusion—Multiple Sales: Areas of impacts and losses of soils from all activities in multiple sales are similar to those areas discussed under vegetation (Sec. IV.E.6).

Effectiveness of Stipulations: There are no stipulations beyond those identified in Sec. II.C.7 that could reduce the impacts to soils.

2. Paleontological Resources:

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Paleontological resources (plant and animal fossils) are nonrenewable. Once they are adversely impacted and or displaced from their natural context, the damage is irreparable.

Under Alternative D, the management-action impacts generally are the same as under Alternative A, except the intensity of the actions would increase due to potential oil and gas exploration.

(2) Oil and Gas Exploration and Development Activities: Paleontological resources are not ubiquitous in the planning area as are wildlife and habitat, and their occurrence is much less predictable. As a result, it is quite possible that no oil and gas exploration or development activities would impact a paleontological resources locale. However, as the area open to exploration and development increases, as it does dramatically in Alternative D, the possibility of no impacts to paleontological resources decreases markedly.

(a) Effects of Disturbance from Disturbance: The types of oil and gas exploration activities that would occur under Alternative D would be the same as those that would occur under Alternative B. However, the level or intensity of these exploration activities would increase dramatically under Alternative D. The number of exploration/delineation wells drilled would increase from 10 in Alternative B to 28, and as many as 6 wells might be drilled in a single winter season. This would increase the probability of potential impact nearly 200 percent over Alternative B.

(b) Effects of Exploration Spills: These effects would be the same as those under Alternative B, except the probability of impacts would be increased by almost 200 percent.

(c) Effects of Disturbance from Development: The types of oil and gas development activities that would occur under Alternative D would be the same as those that would occur under Alternative B. However, the level or intensity of these activities would increase under Alternative D. The number of production pads would increase from two in Alternative B to six in Alternative D, and pipeline miles would increase by 30 for a total of 105 mi under Alternative D. The potential for pump stations also increases in Alternative D. However, as mentioned previously, the variability in causal factors is great enough to make quantification difficult. These factors would increase significantly the potential for impacts over Alternative B.

(d) Effects of Development Spills: These effects would be the same as those under Alternative B, although the possibility of spills is greatly increased.

Conclusion—First Sale: Under Alternative D, impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature but may be significantly increased in magnitude over Alternative B. Under Alternative D, most of the impacts to paleontological resources would result from oil and gas exploration and development. When compared with Alternative B, the potential for impact to paleontological resources would be significantly greater under Alternative D.

Multiple Sales: The potential impacts to paleontological resources under Alternative D could increase by as much as 30 percent compared to Alternative B.

Conclusion—Multiple Sales: Under Alternative D potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under Alternative D, the potential impacts to paleontological resources from oil and gas exploration and development would increase by at least 300 percent compared to Alternative B.

Effectiveness of Stipulations: The effectiveness of stipulations would be the same as under Alternative B.

3. Water Resources:

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may affect water resources under Alternative D would be similar to those under Alternative A, except that the number and frequency of camps and moves would increase slightly. The increase would depend on management actions in land, water, and resource monitoring as related to leasing activities. Because Alternative D emphasizes less protection of surface resources than Alternatives B and C, some of the areas adjacent to streams and lakes (Fish Creek drainage, much of Teshekpuk Lake, and adjacent deepwater lakes) identified as critical aquatic habitat would be available to leasing. Therefore, some of the additional camps and moves likely would be near these critical aquatic habitat areas.

b. Oil and Gas Exploration and Development Activities:

(1) Disturbance: Exploration and development activities within the planning area that may affect water resources under Alternative D would be similar to those in Alternative B, except that the number and frequency of these activities would increase (Table IV.A.1.b-1). The increase would depend on the number of leases sold, the number of proposals for exploratory activity, and the locations of this activity. As noted previously (Sec. IV.B.3.a), some of the areas adjacent to streams and lakes identified as critical aquatic habitat would be available to leasing. Therefore, some of the additional exploration and development likely would be near these critical aquatic habitat areas. The likelihood of exploration and development activities occurring in an area that contains more water resources and critical aquatic habitat areas than Alternative B increases the risk of melting permafrost, disrupting drainage patterns, increasing erosion and sedimentation, and removing water from riverine pools and lakes.

(2) Spills and Spill Cleanup: Under Alternative D, the potential number and extent of oil spills and cleanup would increase from those under Alternatives B and C (Sec. IV.A.2). Alternative D, because it includes more of the critical lake and river habitat than Alternatives B and C, would have greater adverse effects on water resources as compared to Alternatives B and C.

Conclusion—First Sale: The impacts of activities other than oil and gas exploration and development under Alternative D are expected to be similar to those under Alternative B and C. The potential long-term impacts (melting of permafrost, and disrupting drainage patterns) and short-term impacts (increasing erosion and sedimentation and removing water from riverine pools and lakes) of oil and gas exploration and development on the water resources in the planning is expected to be greater for Alternative D than for Alternatives B and C.

Multiple Sales: While the effects of oil and gas exploration and development from multiple sales may be up to several times greater than a single sale, impacts would not necessarily go up proportionally. Shared use of infrastructure such as airfields, roads, camps, and pipelines could significantly reduce the size of the impacted areas and adverse effects to the water resources.

Conclusion—Multiple Sales: Shared infrastructure could reduce the adverse effects to water resources of multiple lease sales, in that combined facilities require less water for construction, maintenance, and camp use than separate, independent facilities.

Effectiveness of Stipulations: The stipulations that are effective in minimizing potential effects of the ground-impacting-management actions on the water resources in the planning area for Alternative D are the same as for Alternative B.

4. Water Quality:

a. Activities Other Than Oil and Gas Exploration and Development: As discussed under Alternative A, ground-impacting-management actions other than seismic operations and other oil and gas activities would not impact water quality.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Exploration activities within the planning area that may affect water quality under Alternative D are 2-D and 3-D seismic activity beyond that described under Alternative A, ice road construction, and pad construction, as found for Alternative B. Under Alternative D, total miles of seismic trails and resulting water degradation would be about twice that for Alternative A. That is, water quality could be degraded over a total of 1,800 acres. For Alternative D, annual ice-pad and -road construction (330-440-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 120 to 170 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 4 to 8 acres of lake. Temporary upslope impoundment of snowmelt waters could cover another 40 acres. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

(2) Development: Development activities within the planning area that may affect water quality under Alternative D are ice-road and -pad construction and spills, as found for Alternative B.

Because of the continued need for ice roads, annual water use during development would be similar to that for exploration, requiring water from 120 to 160 acres worth of intermediate-depth lakes to construct 320 to 420 acres of ice-road. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet per year for each field, requiring about 5 to 20 acres total of lake for water supply. Temporary upslope impoundment of snowmelt waters by ice roads could cover another 40 acres. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or a total of 100 to 400 acres under Alternative D. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 200 to 800 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the field(s). These locations, however, would not be within the area deferred under Alternative D.

Spills are another impacting agent on water quality. A number of small crude spills averaging 4 bbl and smaller fuel spills averaging 0.7 bbl are projected to occur under Alternative D. Only about 8 percent of crude spills can be reasonably expected to reach tundra waters. For Alternative D, this calculation results in an estimate of 3 to 13 spills, each averaging 4 bbl, reaching tundra waters. Over the life of the fields, spills could affect the water quality of 3 to 13 ponds or small lakes, making their waters toxic to sensitive species for about 7 years. These spill locations, however, would not be within the area deferred under Alternative D.

Conclusion—First Sale: Effects under Alternative D are higher than in Alternative B for oil and gas activities. Effects for activities other than oil and gas are similar to those for Alternative A. Annually, water quality up to 3,000 acres could be affected by seismic trails, construction or placement of ice or gravel roads and other structures. Oil spills could result in waters of up to 13 ponds or small lakes remaining toxic to sensitive species for about 7 years.

Multiple Sales: Effects from seismic trails would be similar to that for a single sale. During exploration, annual ice-pad and -road construction (390-620-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 150 to 230 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 4 to 8 acres of lake. Temporary upslope impoundment of snowmelt waters could cover another 60 acres.

Because of the continued need for ice roads, annual water use during development for ice-road construction would be similar to that for exploration, requiring extraction of water from 150 to 230 acres of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 10 to 30 acres of lake for water supply for all fields. Temporary upslope impoundment of snowmelt waters by ice roads could cover another 60 acres.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field air strip would cover about a 100-acre footprint per field, or a 200- to 600-acre total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 1,200 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields.

Over the life of development resulting from multiple sales, spills could degrade water quality of 6 to 27 ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years.

Conclusion—Multiple Sales: Longer-term (decade-or-more) effects of multiple sales would slightly greater than for a single sale. Oil spills could result in waters of up to 27 ponds or small lakes remaining toxic to sensitive species for about 7 years.

Effectiveness of Stipulations: Effectiveness of stipulations is similar to that under Alternative B.

5. Air Quality:

a. Activities Other than Oil and Gas Exploration and Development:

The ground-impacting-management activities that would affect air quality under Alternative D would be the same as those under Alternative A. The impacts of these activities would be the same as those under Alternative A.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Exploration activities within the planning area that may affect air quality under Alternative D are drilling and pad construction, the same as for Alternative C. Under Alternative D, the number of exploratory wells drilled per year would be twice the number under Alternative C.

(2) Development: Development activities within the planning area that may effect air quality under Alternative D are drilling, facility and pipeline construction, and production, the same as under Alternative C. Total number of wells drilled for Alternative D would be approximately one-quarter more that Alternative C. Total emissions from these activities would be limited through permits obtained from the State of Alaska to less than the Clean Air Act standards.

Conclusion—First Sale: Effects of oil and gas activities under Alternative D are similar to those under Alternative C. Annually, air quality would be affected by drilling and construction activities at levels less than the PSD criteria. Effects of activities other than oil and gas are negligible, as in Alternative A.

Multiple Sales: The effects on air quality from multiple sales should result in air emissions that remain below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected.

Conclusion—Multiple Sales: Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.

Effectiveness of Stipulations: Current laws and regulations are assumed to be in place for the analysis of the IAP, and effects levels reflect this assumption.

6. Vegetation:

Ground-impacting-management actions within the planning area that may affect vegetation under Alternative D include those analyzed under Alternative A and those resulting from oil exploration and development analyzed under Alternative B. The impacts of management actions described under Alternative A would be similar under Alternative C, except that the total areal extent of archaeological/paleontological excavations may increase to 5 acres per year and seismic survey activity would increase (see below).

a. Exploration: Impacts of exploration drilling under Alternative D would be of the same types as under Alternative B, but there would be 9 to 28 wells drilled rather than 1 to 10. This scenario could result in the death of vegetation on the perimeters of oversummer ice pads of 0.2 to 0.6 acres of vegetation spread among 5 to 14 different sites. Construction of well collars would cause the destruction of vegetation on 0.05 to 0.2 acres.

The types of impacts of seismic exploration would remain the same as under Alternative B. It is assumed that the number of 2-D surveys would remain the same at one per winter, but that this frequency would continue for about 15 years rather than 10 before decreasing to alternate winters. Because the tundra can recover from about 90 percent of these impacts in 9 years, it is expected that this change would result in little increase in area affected at any one point in time. It also is assumed that the number of 3-D surveys would increase from zero to two over 5 years to two to seven over 15 years. This would result in 92,000 to 322,000 acres impacted by 3-D surveys.

b. Development: The impacts of oilfield development would be of the same types under Alternatives B and D. It is assumed the number of pump stations would remain 0-1, but the number of oilfields developed might increase from 0-1 to 1-4 with a proportional increase in the extent of area impacted. The gravel pads of these oilfields would bury 100 to 400 acres of vegetation. Dust effects would cover 36 to 144 acres, and the effects of a changing moisture regime might affect 200 to 800 acres. Material sites would cause the destruction of 40 to 160 acres, with moisture-regime changes around them affecting another 20 to 80 acres. Pipeline miles would increase, causing vegetation impacts to increase to 2.5 to 3.7 acres. Finally, the occurrence of spills would increase, affecting 1.4 to 6.0 acres.

Conclusion—First Sale: Impacts to vegetation from activities other than oil exploration and development under Alternative D would be the same as those under Alternative A, except that the effects of archaeological excavation might increase from 1 to 5 acres. The impacts of oil exploration and development would be of the same types as for Alternative B, but greater in areal extent. The maximum acreage affected by 3-D seismic surveys would increase from 0 to 92,000 acres to 92,000 to 322,000 acres. The combined effect of development activities would cause the destruction of vegetation on 140 to 600 acres rather than 0 to 180 acres and the alteration in plant species composition of another 220 to 940 acres instead of 0 to 280 acres, for a total of effects over 360 to 1,540 acres rather than 0 to 460 acres. Finally, the occurrence of spills would increase, affecting 1.4 to 6.0 acres instead of 0.5 to 2.6 acres, but the probability of a blowout would remain low.

Multiple Sales: It is assumed that additional lease sales under Alternative D would result in additional exploration activities and a total of two to seven oilfields being developed. More acreage would be impacted by seismic surveys, but it would be over a longer period of time. It is expected that recovery from at least 90 percent of the impacts from the earliest surveys would be complete before additional seismic operations would commence as a result of multiple sales. The total number of exploratory wells is assumed to increase from 4 to 11 to 12 to 44 and delineation wells from 5 to 17 to 12 to 36, for a total of 24 to 80 wells drilled from ice pads. Vegetation destruction from well collars would increase to affect 0.1 to 0.5 acres, and vegetation death around ice-pad perimeters would increase to 0.6 to 2.0 acres. Tundra would recover from the latter in 1 to a few years.

With the assumption of two to seven oilfields developed, the vegetation that might be destroyed by burial under gravel fill would increase to 200 to 700 acres. The area of vegetation around oilfield gravel pads that would undergo change from dust or moisture-regime impacts would be 400 to 1400 acres. The impacts of developing material sites would increase correspondingly to the number of oilfields. This would mean the destruction of vegetation on 80 to 280 acres and effects of moisture-regime changes on 40 to 140 acres. It is assumed that the number of pump stations would remain at 0 to 1, resulting in the burial of 0 to 40 acres and dust or moisture- regime changes on an additional 0 to 60 acres. The number of pipeline miles would increase somewhat under multiple sales, with a total of 105 to 185 mi, resulting in the destruction or alteration of a total of 3.1 to 5.5 acres. The incidence of oil spills would also increase, affecting 2.7 to 12.0 acres of vegetation.

Conclusion—Multiple Sales: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time. Exploration activities would also result in 0.1 to 0.5 acres of permanent vegetation destruction around well collars and alteration of 0.6 to 2.0 acres around ice pads. The activities of oilfield development that would impact vegetation include construction of gravel pads, roads, and airstrips for each oilfield; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on 280 to 1,020 acres and the alteration in plant species composition of another 440 to 1,600 acres, for a total of effects over 720 to 2,620 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills would affect 2.7 to 12.0 acres of vegetation within the planning area. Recovery from spills would take a few years to 2 decades. The probability of a blowout would remain low.

Effectiveness of Stipulations: The effectiveness of stipulations would remain the same as under Alternative B, i.e., there are no stipulations beyond existing management practices that would reduce the above impacts to vegetation.

7. Fish:

a. Activities Other Than Oil and Gas Development: Actions associated with Alternative D that may affect fish include the establishment of large work camps at pre-existing airstrips; small scientific excavations for paleontological, geologic, and soils-related information; the sport harvest of fish by workers; and those associated with fuel spills at fuel-storage sites. The establishment of work camps, scientific excavations, and the sport harvest of fish are not expected to have a measurable adverse effect on arctic fish populations. Fuel spills at fuel-storage sites may adversely affect arctic fish populations.

b. Oil and Gas Exploration and Development Activities: Alternative D also involves several management actions associated with oil and gas development. These include seismic surveys; the construction of gravel drill pads, roads, airstrips, pipelines; and oil spills (drill pad, pipeline, and supply barge). The individual effects of these actions and the chemical agents associated with them have been discussed in previous Beaufort Sea EIS's (e.g., USDOI, MMS, 1996a), which are herein incorporated by reference. The remainder of this analysis focuses on differences in the amount of exposure arctic fish are likely to have to each of these actions in Alternative D as compared to Alternative B. Because the number and/or location of seismic surveys, drill pads, roads, airstrips, and pipelines are unknown for Alternative D, the overall effect of these individual activities on arctic fish cannot be quantified or compared directly to those of other alternatives. What is known is that more of the planning area is exposed to oil and gas development in Alternative D (89%), than in Alternative B (44%). This additional area supports a greater number and diversity of fish than the fish-bearing waters of Alternative B. Additionally, Alternative D exposes more of the more productive fish habitat (e.g., Teshekpuk lake) in the planning area to oil and gas development than is exposed by Alternative C. These differences increase the probable number of oil- and gas-related activities, the probability of their affecting arctic fish populations (roughly 4-5 x higher), and the probable overall effect of Alternative D on fish over that of Alternative B.

(1) Effects of Disturbance:

(a) Effects from Seismic Surveys: Arctic fish are likely to be adversely affected by seismic surveys located above overwintering areas. Likely effects would include avoidance behavior and short-term added stress but also could result in the death of some of the more sensitive lifestages (e.g., juveniles). However, the effect on most overwintering fish is expected to consist of only short-term, sublethal effects. While Alternative D is likely to involve more seismic surveys than Alternative A and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Hence, seismic surveys associated with Alternative D are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations). While Alternative D is likely to involve more fuel spills than Alternative A, the amount of fuel entering fish habitat is not expected to increase significantly. Hence, fuel spills associated with Alternative D are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations).

(b) Effects from Construction: Construction-related activities that may affect arctic fish include the construction of drill pads, roads, airstrips, pipelines; and possibly gravel extraction. The individual effects of these activities for Alternative D are expected to be the same as discussed for Alternative B and are summarized below. However, the likelihood of the above construction-related activities occurring and affecting fish habitat is roughly two to three times greater in Alternative D than in Alternative B. Depending on the specific level and location of implementation, this could result in a corresponding increase in the overall effect of these activities in Alternative D over that of Alternative B.

Construction during exploration would involve freshwater withdrawals for the construction of ice- drill pads, roads, and airstrips. Ice roads or airstrips constructed through overwintering areas <10 ft deep would freeze to the bottom and form a barrier to water circulation, resulting in reduced levels of dissolved oxygen. This could have lethal effects on the fish affected by the barrier. The construction of ice roads and airstrips in non-overwintering areas is expected to have no measurable effect on arctic fish. Freshwater withdrawals may to adversely affect fish, if the water is taken from areas where they are overwintering. Under-ice withdrawals from areas having water and dissolved oxygen levels barely to moderately sufficient to support to overwintering fish would be likely to kill many of the fish overwintering there. The recovery of affected fish populations would be expected in 5 to 10 years. However, withdrawals from freshwater sources that do not support resident fish populations, or from areas having sufficient under-ice reserves of water and dissolved oxygen, are not likely to adversely affect overwintering fish.

Construction during production would involve the construction of gravel drill pads, roads, and airstrips. The effects of gravel construction and gravel extraction activities in high density areas are expected to be spawning failure and mortality for many of the fish affected (an estimated 10-year recovery). No measurable effects on arctic fish populations are expected in low-density areas. The effects of pipeline trenching through overwintering or spawning habitat are likely to be spawning failure and/or mortality of many fish, and a5 to 10-year recovery period. Trenching that avoids these habitats is not expected to adversely affect fish. The difference in the estimated number of pipeline miles (up to 75 mi for Alternative B and up to 105 mi for Alternative D, respectively) is not expected to make a measurable difference in effects on arctic fish in Alternative D.

(2) Effects of Spills: The individual effects of oil on fish for Alternative D are the same as discussed for Alternatives A and B. As discussed therein, lethal effects on fish due to a petroleum-related spill seldom are observed outside the laboratory environment. Sublethal effects are more likely and include changes in growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources; and consumption of contaminated prey. The specific effect of oil on fish generally depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). The oil-spill assessment estimates that the amount of oil spilled during the life of the field would be 656 bbl for Alternative D and 280 bbl for Alternative B. However, neither this difference, nor the fact that oil- and gas-related activities are estimated to be four to five times more likely to affect fish in Alternative D, are expected to alter the overall effect of oil spills on arctic fish. Hence, oil spills associated with Alternative D are expected to have the same overall effect on arctic fish as discussed for Alternative B. Oil spills are expected to lethally or sublethally affect a small number of the arctic fish in the planning area over the production life of the field. Recovery from each spill affecting fish is expected within 3 years.

Conclusion—First Sale: The effect of fuel spills on arctic fish populations in Alternative D are expected to be similar to Alternative A. The individual effects of seismic surveys, construction related activities, and oil spills are expected to be similar to that of Alternative B. However, the likelihood of their occurrence is estimated to be roughly four to five times higher for Alternative D than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of these activities on arctic fish populations in Alternative D over that of Alternative B.

Multiple Sales: The actions most likely to affect arctic fish for the first lease sale have been discussed herein and include seismic surveys, construction related activities, fuel spills, and oil spills. While additional northeastern NPR-A lease sales would involve more seismic surveys than the first sale, and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Seismic surveys associated with multiple sales in Alternative D are expected to have the same overall effect on fish as discussed for the first sale (i.e., no measurable effect on arctic fish populations). For additional northeastern NPR-A lease sales that may occur in the future, the number of production pads and pipeline miles have been estimated (Table IV.A.1.b-7). That table estimates that there would be about twice the number of gravel pads as the first sale (see Table IV.A.1.b-5). On the basis of this estimate, gravel pads for multiple sales are likely to have about twice the effect on arctic fish as the first sale. Because there is little difference in the estimated number of pipeline miles for multiple sales (up to 150) and the first sale (up to 105), they are expected to have a similar effect as discussed for the first sale. It is estimated that up to 1312 bbl of crude oil would be spilled for multiple sales, or about 2 times that of the first sale (estimated at up to 656 bbl). On the basis of this estimate, crude oil spills for multiple sales are expected to have about twice the effect on acrtic fish as the first sale. However, if there were not enough time between sales to allow for full recovery, or if the level of activity of the selected alternatives were significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations is likely to be greater than estimated herein for multiple sales.

Conclusion—Multiple Sales: Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish as the first sale. Gravel pads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.

Effectiveness of Stipulations: The stipulations having the most beneficial effect on arctic fish are the same as discussed for Alternative B. However, due to the increased level of potential oil and gas activity associated with Alternative D over that of Alternative B, the absence of these stipulations may increase adverse effects on arctic fish populations.

8. Birds: This section discusses potentially adverse effects of ground- impacting-management actions on nonendangered birds within the planning area under Alternative D. Such actions potentially may result in disturbance factors, habitat alteration or loss, and fuel or oil spills. Effects on birds exposed to such factors would be similar in type to those discussed under Alternative B.

a. Activities Other than Oil and Gas Exploration and Development: Management actions other than oil and gas exploration and development under Alternative D, and their potential effects, differ from Alternative A approximately as discussed under Alternative B, differing from B primarily in that the Colville River would be recommended for inclusion as a "recreational" river in the WSR System rather than as a "wild" (Alt. B) river. These differ as follows: (1) mineral leases are allowed in the river corridor; (2) roads/trails can be maintained on both sides of the river, including on river banks, with several bridge crossings and numerous access points, and motorized travel on existing roads is permitted; and (3) major public facilities are allowed within the river corridor. These specifications are expected to allow greater levels of habitat degradation and disturbance than Alternatives A, B, or C. Without stipulations to assure avoidance of important habitat areas, raptor nesting success and passerine populations in developed areas of the river corridor are expected to decline under this classification in comparison to the preceding alternatives.

b. Oil and Gas Exploration and Development Activities: Oil and gas leasing would be allowed on most (approximately 89%) of the planning area (Fig. II.C.1-4;

Table IV.A-1), except in the Goose Molting Habitat LUEA. Exploration and development activity under Alternative D will be substantially greater than under Alternative B, with 8 to 18 additional exploratory and delineation wells drilled (9-28 v. 1-10), 1 to 4 additional production pads, and 30-80 additional miles of pipeline (Tables IV.A.1.b-5 and 7). Additional drilling would prolong the period during which disturbance and habitat unavailability would occur two to three winter seasons. Additional production pads would displace any nesting birds from 60 to 110 acres each for the duration of production, and additional pipeline would result in a negligible increase in disturbance during monitoring flights. The additional acreage leased could result in potential exposure of additional areas of concentration for some waterbird species. These differences are expected to result in effects on bird populations that are somewhat increased from those discussed for Alternative B.

Conclusion: Effects of actions other than oil and gas activity under Alternative D are expected to be essentially the same as for Alternative B, except in the Colville River corridor where increased activity would result in substantially greater effects. Effects of oil and gas activity is not expected to be significantly greater than discussed for Alternative B.

Multiple Sales: If multiple sales occur in the area available for leasing under Alternative D, intensive construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Approximately three times the number of exploration and delineation wells may be drilled (24-80 v. 9-28), the number of fields developed doubling (2-7 v. 1-4), and production pads are expected to at least double (3-12 v. 1-6), with multiple sales (Tables IV.A.1.b-4, 5, 6, and 7). Pipeline mileage (80-105 mi) is expected to increase to 95 to 150 mi. Surface, air, and foot traffic are expected to increase substantially in some areas if oilfield facilities are grouped in high resource-interest areas; if these coincide with high bird-concentration areas greater numbers of individuals are expected to be displaced and more species involved than with a single sale. Such increases may cause substantial changes in planning area bird population levels and/or distribution. Effects from disturbance and habitat alteration or loss on birds is expected to increase throughout most of the planning area with multiple sales under Alternative D.

The estimated number of onshore oil spills >1 bbl is expected to increase from 9 to 41 for the first sale to 17 to 82 with multiple sales (Tables IV.A.2-3a, -3b); this doubling of spills is expected to cause substantially greater loss of individuals and increased number of species involved. An increase from 86 to 383 small refined-oil spills under the first sale (average size of 29 gal) to 172 to 766 with multiple sales is expected over the production life of the planning area (Tables IV.A.2-3a, IV.A.2-3b, IV.A.2-6a and IV.A.2-6b). Although these small, chronic spills generally are contained and cleaned up on pads and roads, a doubling of their occurrence is expected to have similar increased effect on birds and their habitats as with the first sale under Alternative D. Habitat contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect populations significantly.

Conclusion—Multiple Sales: Displacement of birds from disturbance and habitat alteration or loss is expected to increase throughout most of the planning area under Alternative D with multiple sales, substantially changing planning area bird population levels and/or distribution. Increases in oil and refined oil spills are expected to result in the loss of numbers of birds than under the first sale, but these losses are not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect is expected to increase substantially from that discussed for the first sale.

Effectiveness of Stipulations: Effectiveness of stipulations under Alternative D is expected to be essentially the same as described under Alternatives A, B, and C. Specific stipulations would decrease potential disturbance by: seasonally restriction of drilling in the Goose Molting Habitat LUEA (21); minimizing pads and connecting roads (29); consolidation integration of oil and gas facilities (30).

9. Mammals:

a. Terrestrial Mammals:

Among the terrestrial mammal populations that could be affected under Alternative D are caribou of the Teshekpuk Lake Herd (TLH) and the Central Arctic Herd (CAH). Moose, muskoxen, grizzly bears, wolves, wolverines, and arctic foxes may be locally affected by planning-area activities.

(1) Activities Other than Oil and Gas Exploration and Development: The level of activities such as resource inventories, aerial surveys, and research camps is expected to increase somewhat under Alternative D as compared to Alternative A, but the level of effect is expected to be about the same.

(2) Oil and Gas Exploration and Development Activities: Under Alternative D, one to four oilfields are assumed to be discovered and developed. Primary effects on terrestrial mammals would come from motor-vehicle traffic within the oilfield(s). Other effects could come from foot traffic near facilities and camps; from aircraft traffic; from small, chronic crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and from habitat alteration associated with gravel mining and construction. (Please see Alternative B, Sec. IV.C.9.a. for a discussion of general effects of disturbance and spills.) The planning area can be divided into thirds—northern (including Teshekpuk Lake and the Beaufort coast), middle (the area generally west and southwest of Nuiqsut), and southern. Under Alternative D, portions of the northern area and all the middle and southern areas would be open for leasing and development (Fig. II.C.1-4).

(a) **Effects of Disturbance**: If a field is developed in the northern planning area south and west of Teshekpuk Lake, production pads, pipelines, within-field roads, and other facilities (housing, airfield, processing plant) would be located within the southern portion of the TLH calving area (Fig. III.B.5.a-1). Some calving is expected to be displaced within 1.86 to 2.48 mi (3-4 km) of within-field roads. Movements of some cows and calves across these roads is expected to be reduced, and cow caribou may avoid crossing the roads during the calving season. Some displacement of calving caribou is expected to occur. Some TLH movements during the insect-relief season (late June-August 15) are expected to be adversely affected by pipelines and road traffic. However, most caribou movements to coastal insect-relief areas occur to the east of the lake and are not expected to be affected.

If a field is developed in the middle planning area, there would be no effect on TLH calving or the TLH calving area. Some TLH migration movements may be adversely affected by air and surface traffic along pipelines and roads within the oilfield. If a field is developed in the southern planning area, some members of the CAH, WAH, and TLH would encounter the field during their fall-migration route and within a portion of their winter range. However, neither the pipeline to the TAPS nor facilities within the oilfield would be expected to significantly affect the movement of caribou or alter their distribution or abundance.

A pipeline from the oilfield(s) would connect to the TAPS through facilities at the Alpine and Kuparuk River fields. The pipeline would be constructed during winter using ice roads, so that no permanent road would be associated with the pipeline. During construction, air traffic would include several flights per day, which temporarily could disturb some of the caribou of the TLH and CAH and other terrestrial mammals within about 1.2 mi (2 km) of the pipeline. Disturbance effects on caribou and other terrestrial mammals are expected to be short term, interference with mammal movements would be temporary (probably a few minutes to less than a few days), and the mammals eventually would cross the pipeline area. Additionally, disturbance reactions would diminish after construction, and flights would decrease to about one or two per day at most. The abundance and overall distribution of terrestrial mammals are not expected to be affected by pipeline construction or operation.

(b) **Effects of Spills**: For general information on the effects of oil spills on terrestrial mammals, please see the discussion under Alternative B (Sec. IV.C.9.a). Chronic crude-oil and fuel spills from onshore activities and possible marine transportation probably would result in the loss of small numbers of terrestrial mammals. Under Alternative D, approximately 9 to 41 (>1 bbl) crude-oil spills (averaging 4 bbl) and 86 to 383 small, refined-oil spills (averaging 29 gal) are assumed to occur onshore over the production life of the planning area (Tables IV.A.2-2 and 2-6). These small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B.

Conclusion—First Sale: Activities other than oil and gas are expected to increase somewhat under Alternative D a compared to Alternative A, but the increase is not expected to affect terrestrial mammal populations. For oil and gas activities, effects of Alternative D are expected to be significantly greater than those of Alternative B, with more helicopter disturbance of caribou and other terrestrial mammals. Increased habitat alteration would include the development of one to four oilfields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic. Near the oilfields, surface, air, and foot traffic are expected to increase and to displace some terrestrial mammals, but not significantly affect Arctic Slope populations. If a field is developed in the area south and west of Teshekpuk Lake, some TLH caribou calving is expected to be displaced within 1.86 to 2.48 mi (3-4 km) of roads and other production facilities over the life of the project. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 to 2 years.

Multiple Sales: If several lease sales occur under Alternative D, considerably more exploration activity is expected to occur along the coast of the Colville River Delta-southern Harrison Bay area with the number of exploration wells drilled increasing from 4 to 11 under the first sale to 12 to 44 under multiple sales. The amount of development also is expected to increase, with the number of oilfields increasing from 1 to 4 under one sale to 2 to 7 under multiple sales, with the number of production pads increasing from 1 to 6 under one sale to 3 to 12 under multiple sales and miles of pipeline increasing from 80 to 105 under the first sale to 95 to 150 under multiple sales. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, an increase the potential displacement of calving TLH caribou could occur along roads between the production pads and other facilities assumed to be located south of Teshekpuk Lake. An increase in the number or miles of roads and other facilities with development under multiple sales is also expected to increase the impedance of TLH caribou movements to insect-relief areas along the coast, north of Teshekpuk Lake. The displacement of calving caribou represents a functional loss of habitat within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH.

Under Alternative D multiple sales, the number of small crude-oil spills (>1 bbl) is expected to increase from an estimated 9 to 41 under the first sale to 17 to 82 under multiple sales (average size of 4 bbl) and a total of 86 to 383 small fuel-oil spills under the first sale (average size of 29 gal) to 172 to 766 under multiple sales are estimated to occur onshore over the production life of the planning area (Tables IV.A.2-3a, IV.A.2-3b, IV.A.2-6a, and IV.A.2-6b). These small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative D with the first sale but with a loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations.

Conclusion—Multiple Sales: The effect of multiple sales under Alternative D is expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads assumed to be built between production pads south of Teshekpuk Lake. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect-relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude- and fuel-oil spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.

Effectiveness of Stipulations: Stipulations described in Section II.C.7 in regard to solid- and liquid-waste disposal, fuel handling, and spill cleanup are expected to reduce the potential effects of spills and human refuse on terrestrial mammals. Stipulations on overland moves and seismic work are expected to minimize alteration of terrestrial mammal habitats. The stipulation on aircraft to maintain 1,000 ft AGL (except for takeoffs and landings) over caribou winter ranges from October through May 15, and to maintain 2,000 ft AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, is expected to minimize disturbance of caribou. The designation of the Colville River as a "recreational" river under the Wild and Scenic Rivers System is not expected to provide any significant reduction in potential effects of caribou or other terrestrial mammals.

Stipulations on oil and gas exploration and development, including facility design and construction, are expected to minimize alteration of terrestrial-mammal habitat and interference with caribou movements. Stipulations that restrict permanent surface occupancy of oil and gas facilities within 2 mi of the coast and east of Teshekpuk Lake to Kogru Inlet are expected to reduce disturbance and interference with caribou movements, in particular the movements of caribou to and from the coast for insect relief and the movements of TLH cow caribou to calving habitats north of the lake. Stipulations requiring elevated pipelines and roads to be separated at least 500 ft and to place pipelines on the appropriate side of the road (depending on general movements of caribou in the area) could significantly reduced interference with caribou movements.

b. Marine Mammals: Under Alternative D, coastal areas near the Colville River Delta and in southern Harrison Bay would be open to oil and gas leasing. Six species of marine mammals—ringed, spotted, and bearded seals, walruses, polar bears, and belukha whales—commonly occur year-round or seasonally in coastal habitats adjacent to the planning area. Under Alternative D, some individual members of these species may be exposed to effects from oil and gas exploration and development as well as other activities.

(1) Activities Other than Oil and Gas Exploration and Development: Such activities along the coast that may affect marine mammals include aerial surveys (including surveys of wildlife); ground activities such as resource inventories, paleontological excavations, research and recreation camps; and overland moves. Effects under Alternative D would be similar to those for Alternative A—local and short term, with no significant adverse effects to the populations as a whole.

(2) Oil and Gas Exploration and Development Activities: Oil and gas exploration and development activities along the coast that may affect marine mammals are noise and disturbance from air and surface traffic, geophysical seismic activities. Small onshore crude- and fuel-oil spills associated with Alternative D are not expected to reach the marine environment and affect marine mammals.

(c) Effects of Noise and Disturbance: Noise associated with oil and gas activities is a main source of disturbance of seals, polar bears, and belukha whales. For a discussion of the nature of airborne- and underwater-noise effects on pinnipeds, polar bears, and belukha whales, see the Sale 124 FEIS (USDOI, MMS, 1990). A discussion of noise and disturbance effects specific to the planning area follows.

The primary source of noise and disturbance would come from air traffic along the coast of the planning area from the Colville River Delta west to Kogru Inlet, specifically from helicopters associated with the assumed oil exploration and production activities. Aircraft traffic (several helicopter round trips/day during exploration and development) centered out of Deadhorse-Prudhoe Bay and perhaps Camp Lonely, traveling to and from NPR-A exploration and production facilities, is assumed to be a source of disturbance to ringed or spotted seals hauled out on ice or beaches, respectively, and polar bears using coastal habitats.

During the summer, some of the air traffic to and from exploration and production facilities could disturb spotted seals hauled out along the coast, causing them to charge in panic into the water. Because of frequent low visibility due to fog, aircraft may not always be able to avoid disturbing hauled-out seals. The number of seals affected would depend on the number of disturbance incidents. Aircraft disturbance of hauled-out seals in the planning area could result in injury or death to young seal pups. Although air-traffic disturbance would be very brief, the effect on individual seal pups could be severe. Aircraft disturbance of small groups of spotted and ringed seals hauled out along the coast is not likely to result in the death or injury of large numbers of seals, although increases in physiological stress caused by the disturbance might reduce the longevity of some seals if disturbances were frequent.

If exploratory drilling occurs during the winter (early December–mid-April) near the coast, polar bears could be attracted to the oilfield camps by food odors and curiosity. Some polar bears could be unavoidably killed to protect oil workers. However, the number of bears lost as a result of such encounters is expected to be very low.

(b) Effects of Geophysical Seismic Activities: Effects would be similar to those under Alternative A: short-term effects on a small number of polar bears that den along the coast of the planning area could occur.

Conclusion—First Sale: For marine mammals, the effects of activities other than oil and gas under Alternative D are expected to be similar to those under Alternative A—local and short term, with no significant adverse effects to the populations as a whole. The effects of oil and gas activities for Alternative D are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects are expected to occur in the Colville River Delta-southern Harrison Bay area.

Multiple Sales: If several lease sales occur under Alternative D, considerably more exploration activity is expected to occur along the coast of the Colville River Delta-southern Harrison Bay area, with the number of exploration wells drilled increasing from 4 to 11 under the first sale to 12 to 44 under multiple sales. The amount of development also is expected to increase, with the number of oilfields increasing from 1 to 4 under the first sale to 2 to 7 under multiple sales, the number of production pads increasing from 1 to 6 under the first sale to 3 to 12 under multiple sales, and pipeline miles increasing from 80 to 105 under the first sale to 95 to 150 under multiple sales. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects on polar bears and seals is expected to occur in the Colville River Delta-southern Harrison Bay area. This increased activity could result in an increase in aircraft disturbance of seals hauled out on the ice along the coast in Harrison Bay and the Colville River Delta. An increase in onshore surface-traffic activity (seismic exploration, overland moves, construction activities along the coast) could result in more disturbance of polar bears denning and foraging along the coast. However, these effects are expected to be local and short term, with no significant adverse effects to the polar bear and seal populations as a whole.

Conclusion—Multiple Sales: Multiple sales under Alternative D are expected to have effects similar to those under Alternative D with the first sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Effectiveness of Stipulations: The effectiveness of stipulations is expected to be the same as under Alternative A.

10. Endangered and Threatened Species:

a. Activities Other Than Oil and Gas Exploration and Development: Such activities associated with the management plan still would occur under this alternative. Ground-impacting-management actions within the planning area that may affect bowhead whales and spectacled and Steller's eiders under Alternative D include aerial surveys (including wildlife) and ground activities such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall. A description of these activities and potential effects on these species is contained in Section IV.B.10 (Alternative A) and summarized herein. The potential effects from these activities are expected to be essentially the same as described for Alternative A. A detailed discussion of all management actions is found in Section II.

Bowhead whales are not likely to be affected by any activities associated with the management plan. Some eiders may be affected by activities associated with aircraft traffic and hazardous- and solid-material removal and remediation. Under this alternative, there would be an increase in the number of aircraft flights for point-to-point flights, aerial wildlife surveys, and other aerial surveys. Point-to-point flights increase from occasional to daily flights. Aerial wildlife surveys increase from 14 days to 21 days during June and July and other aerial surveys increase from occasional flights to several 2- to 3-week periods (Table II.D.3). Summertime aircraft flights over sensitive areas for eiders may affect nesting females and their broods. Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake (spectacled eider LUEA, Fig. II.B.3) may be overflown by aircraft (both helicopters and fixed wing) on a regular basis during the summer months and may experience temporary, nonlethal effects lasting probably less than an hour. Due to the relatively low density of eiders in the area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

b. Oil and Gas Exploration and Development Activities: Under Alternative D, oil and gas leasing would occur in the planning area, although most of the spectacled eider LUEA, an area north and east of Teshekpuk Lake, is unavailable for oil and gas leasing. This analysis is based on a development scenario presented in Section IV.A.1.b of this EIS. The reader is referred to these sections for a discussion of resource-recovery rates and quantities, timing of infrastructure development, platform emplacement, wells drilled, and resource production timeframes and other information relevant to the development of the resources of the proposed action. The BLM proposes to conduct multiple oil and gas lease sales within the planning area. Multiple sales are discussed later in this section. Under Alternative D, oil resources for the initial sale are expected to be in the 185- to 825-MMbbl range with from 1 to 4 fields, which is considered a reasonable range of resource development and activity level for the portion of the planning area open to leasing (Table IV.A.1.b-4). Information on the number of exploration, delineation, and production wells anticipated to be drilled and pipeline miles can be found in Table IV.A.1.b-5. Differences in effects on the species as a result of noise and disturbance over this range of scenarios are expected to be minor. Differences in effects on the species as a result of an oil spill during the development/production scenario (185-825-MMbbl-resource range) also are expected to be minor.

For Alternative D, it is estimated that from 28 to 123 spills <1 bbl would occur, and from 9 to 41 spills >1 bbl would occur over the assumed production life of the planning area (Table IV.A.2-3a). For the purposes of analysis, this EIS assumes an average spill size of 4.0 bbl and that the estimated number of crude-oil spills over the assumed production life of the planning area would range from 37 to 164 spills (Table IV.A.2-2a). Information pertaining to oil spills can be found in Section IV.A.2.

(1) Effects on the Bowhead Whale: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills associated with oil and gas activities or other activities associated with the management plan are expected to be essentially the same under this alternative as under Alternative B.

(2) Effects on the Spectacled and Steller's Eiders: The potential effects on spectacled and Steller's eiders from discharges, seismic surveys, construction activities, and oil spills associated with oil and gas activities are expected to be essentially the same under this alternative as under Alternative B. The potential effects as a result of noise and disturbance associated with oil and gas activities, such as aircraft traffic, vessel traffic, and perhaps drilling of development and production wells and oil-spill-cleanup activities, may increase slightly, although most spectacled eider breeding and nesting areas are in an area unavailable for oil and gas activities under this alternative. One area to the west and southwest of Teshekpuk Lake, part of the spectacled eider LUEA, is available for drilling and has a relatively high density of eiders compared to areas south of Teshekpuk Lake. Eiders exposed to noise and disturbance from oil and gas activities may experience temporary, nonlethal effects lasting probably less than an hour but possibly continuing all summer, in the case of summer drilling operations. However, most of the spectacled eider breeding and nesting areas are closed to oil and gas activities under this alternative. Although Steller's eiders are present in the planning area, it isn't known for sure if they actually breed in the planning area. Because no oil and gas activities would occur in this area, those eiders will not be affected by oil and gas activities. Some Steller's eiders in the remainder of the planning area may experience some noise and disturbance as a result of oil and gas activities and may experience temporary, nonlethal effects lasting probably less than an hour but possibly continuing all summer in the case of summer drilling operations. However, it is unlikely that the primary Alaskan nesting area, located south and southeast of Barrow, would be affected much by these activities; so significant disturbance of nesting or broodrearing eiders is not expected to occur. The effects to eiders should be limited, with only a few eiders exposed to oil and gas activities.

Conclusion—First Sale: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills are expected to be essentially the same under this alternative as under Alternative B. The potential effects on spectacled and Steller's eiders from discharges, some noise and disturbance, and oil spills associated with oil and gas activities are expected to be essentially the same under this alternative as under Alternative B. Most spectacled eider breeding and nesting areas are protected under this alternative, because no oil and gas activities are permitted in most of the sensitive area. Some eiders in the area open to oil and gas activities may experience temporary, nonlethal effects as a result of increased aircraft traffic, vessel traffic, and perhaps drilling of development and production wells and oil-spill-cleanup activities. Some Steller's eider breeding and nesting areas also would be protected under this alternative, although some eiders in the remainder of the planning area may experience some noise and disturbance as a result of oil and gas activities and may experience temporary, nonlethal effects lasting probably less than an hour but possibly continuing all summer in the case of summer drilling operations. There also may be an increase in potential effects on eiders from activities associated with the management plan other than oil and gas activities, due to an increase in summertime aircraft flights over sensitive areas, that may affect nesting females and their broods. Under this alternative there will be an increase in the number of aircraft flights for aerial wildlife surveys and other aerial surveys. Aerial wildlife surveys in late June and early July increase from 14 days to 21 days. Spectacled and Steller's eiders breeding, nesting, or rearing young in coastal habitats may be overflown by support aircraft and may experience temporary, nonlethal effects lasting probably less than an hour. In the central portion of the planning area, Steller's eiders may occasionally be overflown by support aircraft and may experience temporary, nonlethal effects lasting probably less than an hour. It is unlikely that the primary Alaskan nesting area, located south and southeast of Barrow, would be affected much by these activities; so significant disturbance of nesting or broodrearing eiders is not expected to occur. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative D increases from a range of 185 to 825 MMbbl in one to four oilfields (Table IV.A.1.b-4) to a range of 370 to 1650 MMbbl in two to seven oilfields (Table IV.A.1.b-6). The number of exploration wells increases from a maximum of 11 to 44, delineation wells increase from a maximum of 17 to 36, and production wells increase from a maximum of 248 on 6 pads to 495 on 12 pads. Pipeline miles increase from 105 to 150 mi (Tables IV.A.1.b-5 and 7). Multiple sales would occur over a longer period of time and, depending on frequency of sales and results from exploratory drilling operations, possibly increase the timeframe for oil and gas activities in the planning area by a couple of decades.

For Alternative D, it is estimated that the number of spills <1 bbl would increase from a range of 28 to 123 spills to a range of 56 to 246 spills, and the number of spills >1 bbl would increase from a range of 9 to 41 spills to a range of 17 to 82 spills over the assumed production life of the planning area (Tables IV.A.2-3a and IV.A.2-3b). The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 37 to 164 spills to a range of 74 to 328 spills (Tables IV.A.2-2a and IV.A.2-2b). Information pertaining to oil spills can be found in Section IV.A.2.

Conclusion—Multiple Sales: The effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the first sale.

Effectiveness of Stipulations: The effectiveness of stipulations for noise and disturbance from oil and gas activities are the same as for Alternative B, and from activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, the same as Alternative A.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: Alternative D would generate recreation-field employment is generated by 30, 1-week long float-trip parties per year (Table II.H.3.b), equal to one person for 8 months each year.

b. Oil and Gas Exploration and Development Activities: Increased revenues and employment are the most significant economic effects that would be generated by Alternative D. Increased property-tax revenues and new employment would be created with the construction,

Table IV.E.11-1
Summary of Employment Forecasts, Alternative D

	IAP Employment in Enclave			NSB Resident Employment		
	Without IAP Activity	With IAP Activity		Without IAP Activity	*Increase with IAP Activity*	
Year		$18/bbl	$30/bbl		$18/bbl	$30/bbl
1999	0	0	0	1,865	0	0
2000	0	99	99	1,825	2	2
2001	0	179	259	1,794	8	9
2002	0	179	339	1,767	12	19
2003	0	199	519	1,746	13	27
2004	0	59	299	1,730	12	31
2005	0	429	589	1,716	13	28
2006	0	1,318	2,452	1,701	45	77
2007	0	951	1,544	1,685	46	66
2008	0	894	1,599	1,662	21	36
2009	0	775	3,008	1,614	17	72
2010	0	565	1,631	1,565	17	34
2011	0	476	3,270	1,513	11	74
2012	0	550	2,237	1,470	14	61
2013	0	496	2,087	1,431	16	66
2014	0	496	2,110	1,393	16	72
2015	0	536	1,300	1,357	20	55
2016	0	536	1,300	1,350	20	55
2017	0	536	1,200	1,330	20	55
2018	0	536	1,200	1,310	20	50
2019	0	536	1,200	1,290	20	50
2020	0	536	1,200	1,290	20	50
2021	0	536	1,200	1,310	20	50
2022	0	536	1,200	1,330	20	50
2023	0	536	1,200	1,350	20	50
2024	0	536	1,200	1,370	20	50
2025	0	536	1,200	1,390	20	50
2026	0	536	1,200	1,410	20	50
2027	0	536	1,200	1,430	20	50
2028	0	536	1,200	1,450	20	50

Sources: Resident employment 1999–2015, Rural Alaska Model, North Slope Borough, 1996; IAP employment and resident employment 2016–2028, Manpower Model and MMS.

Table IV.E.11-2
Summary of NSB Population Forecasts, Alternative D

		Increase in Resident Population				Increase in Resident Population	
Year	Resident Population No IAP Activity	IAP Activity $18/bbl	IAP Activity $30/bbl	Year	Resident Population No IAP Activity	IAP Activity $18/bbl	IAP Activity $30/bbl
1999	6,067	0	0	**2014**	6,582	48	216
2000	6,134	6	6	**2015**	6,423	51	165
2001	6,213	24	27	**2016**	6,300	51	165
2002	6,301	36	57	**2017**	6,200	51	165
2003	6,391	39	81	**2018**	6,100	51	150
2004	6,488	36	93	**2019**	6,000	51	150
2005	6,684	39	84	**2020**	6,000	51	150
2006	6,695	135	231	**2021**	6,100	51	150
2007	6,820	138	198	**2022**	6,200	51	150
2008	6,918	63	108	**2023**	6,300	51	150
2009	7,011	51	216	**2024**	6,400	51	150
2010	7,050	51	102	**2025**	6,500	51	150
2011	7,004	33	222	**2026**	6,600	51	150
2012	6,891	42	183	**2027**	6,700	51	150
2013	6,743	48	198	**2028**	6,800	51	150

Sources: For years 1999–2015, Rural Alaska Model, North Slope Borough, 1996. For 2016–2028, MMS.

operation, and servicing of facilities associated with oil and gas activities. These facilities are described in Table IV.A.1.b-1 and are summarized as follows. For exploration, 4 to 11 exploration and 5 to 17 delineation wells would be drilled between 2000 and 2009; for development, 56 to 248 production and service wells would be drilled, 1 to 6 production pads constructed, and 80 to 105 mi of onshore pipeline installed between 2006 and 2016. The number of workers needed to operate the infrastructure is determined by the scale of the infrastructure and not by the amount of oil produced. A wide range of production volume can be handled by a given level of infrastructure. Once the infrastructure is constructed, the number of workers needed to operate it does not depend on the amount of product flowing through it. Effects include employment generated by seismic surveys during exploration. State property-tax revenues are in proportion to the value of onshore facilities. State royalty income and State severance tax are in proportion to production. Peak yearly production is estimated at 16 to 61 MMbbl. (For complete descriptions of resources and associated activity, see Sec. IV.A.1.b.)

(1) **North Slope Borough Revenues and Expenditures**: Exploration, development, and production are projected to generate increases in property taxes above the levels without Alternative D activities starting in 2000 and averaging about 2 to 4 percent each year through the production period, or about $4 to $8 million.

(2) **NSB Employment**: The gains from Alternative D in direct employment would include jobs in petroleum exploration, development, and production and jobs in related activities (Table IV.E.11-1). Direct employment is anticipated to peak in the range of 1,300 to 3,200 jobs during the development phase, and decline to a level in the range of 500 to 1,200 during production from 2017 to 2028.

Total NSB resident employment is anticipated to increase in the range of 46 to 77 jobs in the peak of development and level off to 20 to 50 during production after 2017 (Table IV.E.11-1). The peak increase in resident employment is about 3 to 5 percent greater with Alternative D than without during development, and about 1 to 4 percent greater during production. The increase in employment opportunities may partially offset declines in other job opportunities and delay expected outmigration. Increases in resident population will correspond to increases in employment (Table IV.E.11-2).

No workers will be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

(3) **Effects of Subsistence Disruptions on the NSB Economy**: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents primarily through the direct loss of subsistence resources. See Section IV.E.13 for effects on subsistence-harvest patterns.

(4) **State Revenues**: State revenues will increase as a result of Alternative D. Property-tax revenues to the State will be approximately 25 percent of the revenues to the NSB, or $1 to $2 million annually. State royalty income will be in proportion to production, or approximately $0.25 million for each 1 MMbbl of oil produced and flowing through the TAPS, or $2 to $7 million annually. State severance tax will be half that amount, or $1 to $3.5 million annually.

(5) **Southcentral Employment**: Workers in the enclave centered at Prudhoe Bay probably would commute to permanent residences in Southcentral Alaska, Fairbanks, and outside the State. However, for the purpose of this analysis, it is assumed all of the enclave workers (Table IV.E.11-1) commute to Southcentral and have permanent residences there except during peak construction years.

Population in Southcentral generated directly and indirectly by enclave workers during production will be in the range of 7,500 to 18,000, or 2 to 4.8 percent of the Southcentral population. In the 7-year period of the exploration and development phases, the population directly and indirectly associated with Alternative D would rise to the level sustained during production.

Conclusion—First Sale: For activities other than oil and gas exploration and development for Alternative D, approximately 50 jobs for 4½ months associated with seismic surveys and recreation employment equivalent to one person working 8 months per year would be generated. For oil and gas exploration and development activities, production in Alternative D is projected to generate increases above the levels of Alternative B as follows: NSB property taxes, 2 percent ($4-$5 million); direct oil-industry employment, 500 (5x this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 1 to 2 percent; and annual revenues to the State of $1 to $1.25 million, $2 to $3 million, and $1 to $1.5 million from property tax, royalty income, and severance tax, respectively.

Multiple Sales: The effect of multiple sales for Alternative D is projected to be approximately two times that of the first sale for Alternative D.

Conclusion—Multiple Sales: The effect of multiple sales for Alternative D is projected to be approximately two times that of the first sale for Alternative D.

Effectiveness of Stipulations: Stipulations would not change potential economic effects.

12. Cultural Resources:

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Cultural resources (the physical remains resulting from the activities of historic or prehistoric humans) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative D, the management-action impacts generally would be the same as under Alternative A, except the intensity of the actions would increase due to potential oil and gas exploration.

(2) Oil and Gas Exploration and Development Activities:

(a) Effects of Disturbance from Exploration: The types of oil and gas exploration activities that would occur under Alternative D would be the same as those that would occur under Alternative B. However, the level or intensity of these exploration activities would increase dramatically under Alternative D. The number of exploration/delineation wells drilled would increase from 10 in Alternative B to 28, and as many as 6 might be drilled during a single winter season. This would increase the area of potential impact nearly 200 percent over Alternative B.

(b) Effects of Exploration Spills: These effects would be the same as those under Alternative B, except the possibility of impacts would be increased by almost 200 percent.

(c) Effects of Disturbance from Development: The types of oil and gas development activities that would occur under Alternative D would be the same as those that would occur under Alternative B. However, the level or intensity of these development activities would increase under Alternative D. The number of production pads would increase from two in Alternative B to six in Alternative D, and pipeline miles would increase by 30 for a total of 105 mi under Alternative D. The potential for pump stations also increases in Alternative D. However, as mentioned previously, the variability in causal factors is great enough to make quantification difficult. These factors would increase significantly the potential for impacts over Alternative B.

(d) Effects of Development Spills: These effects would be the same as those under Alternative B, although the possibility of spills would be greatly increased.

Conclusion—First Sale: Under Alternative D, impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature but may be significantly increased in magnitude over Alternative B. Under Alternative D, most of the impacts to cultural resources would result from oil and gas exploration and development, although there is a possibility that no such activities would impact cultural resources sites. When compared with Alternative B, the potential for impact to cultural resources would be significantly greater under Alternative D.

Multiple Sales: The potential impacts to cultural resources under Alternative D could increase by as much as 300 percent compared to Alternative B.

Conclusion—Multiple Sales: Under Alternative D, potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under Alternative D, the potential impacts to cultural resources from oil and gas exploration and development would increase by at least 300 percent compared to Alternative B.

Effectiveness of Stipulations: The effectiveness of stipulations would be the same as under Alternative B.

13. Subsistence-Harvest Patterns:

This section analyzes the impacts of ground-management actions and oil and gas leasing on the subsistence-harvest patterns of communities in or near the planning area. This analysis is organized by types of effects and discusses effects on subsistence-harvest patterns on each affected community as a result of disturbance and oil spills. Analytical descriptions of affected resources and species, a more in-depth discussion of the parameters for subsistence-harvest patterns impact analysis, as well as indigenous Inupiat knowledge concerning effects are described in more detail in the discussion for Alternative B (Sec. IV.C.13).

Under Alternative D, only the high-value Goose Molting Habitat LUEA would be made unavailable to oil and gas leasing, making the Teshekpuk Lake Watershed, Spectacled Eider Nesting Concentration, Fish Habitat, and Teshekpuk Lake Caribou Habitat LUEA's available to oil and gas leasing (4.15 million acres would be available and .51 million would be unavailable to oil and gas leasing). The Colville River would be recommended as a "recreational" river in the Wild and Scenic Rivers System and managed as such. Lease-specific stipulations to protect water quality; fish habitat; wetlands; caribou-calving, -

migration, and insect-relief areas; and subsistence resources and access would be in place to minimize impacts to these resources.

Portions of the Colville River would remain available to oil and gas leasing, aboveground pipelines, and gravel extraction. Raptor, passerine, and moose areas on the Colville River and recreation and scenic areas would also be available to oil and gas leasing with certain restrictions for the siting of pipelines and roads. The BLM would recommend the Secretary of the Interior establish the Pik Dunes and the Ikpikpuk Paleontological Sites as special areas.

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. Disturbance impacts from increased aircraft traffic associated with resource inventories and surveys to birds caribou, moose, muskoxen, and other terrestrial mammals would cause brief disturbance reactions lasting from a few minutes up to an hour, potentially causing terrestrial mammals to avoid research, survey, and recreation camps during the 4- to 6-week field season. No overall increase is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area, even with this increased disturbance from aircraft flights. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil-exploration activities—seismic activity and exploration drilling—would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads on low-ground-pressure vehicles from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment could be barged to coastal staging areas in the summer and moved inland the following winter. Seismic surveys would continue on the NPR-A, if a leasing program occurs. Under Alternative D, 1 to 4 fields with a resource range of 185 to 825 MMbbl of oil are estimated. Four to 11 exploration wells would be drilled. For development, 5 to 17 delineation and from 56 to 248 production and service wells would be drilled, as well as from 80 to 105 mi of pipeline constructed.

(a) Effects of Disturbance: Sources for disturbance from exploration and development essentially would be the same as those discussed for Alternative B, except for possible barge-resupply traffic. Because of projected summer supply barge traffic in the open water, potential impacts from noise to migrating bowhead whales could occur, although normal migration would tend to keep the whales offshore and away from nearshore barge traffic.

(b) Effects of Spills: Under Alternative D, one to four fields with a resource range of 185 to 825 MMbbl are estimated. Oil-spill-occurrence estimates over the assumed production life of the planning area range from 37 to 164 crude oil spills, with a volume range from 148 to 656 bbl (average spill size equals 4 bbl). For spills >1 bbl, the range is from 9 to 41 spills. For TAPS spills resulting from NPR-A production, the number of spills ranges from 3 to 12, with a volume ranging from 3 to 13 bbl. Oil-spill-occurrence estimate for TAPS tanker spills resulting from NPR-A resources is a 40- to 82-percent chance of 0 spills (with an average spill size of 30,000 gal) occurring. Eighty-six to 383 refined-oil spills (diesel fuel, aviation fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil), with an estimated volume ranging from 59 to 265 bbl (average spill size equals 29 gal) are estimated. Historically, by volume, diesel fuels account for 75 percent of the refined-oil spills. All NPR-A scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. Adequate data are not available to estimate a chance of such an occurrence. Records indicate four pipeline leaks, with the largest discharge being 125 bbl. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would substantially affect the subsistence harvest (see Secs. III.B.5, Marine Mammals and IV.C.13, Subsistence).

Because of possible summer supply-barge traffic in the open water, potential impacts from noise and fuel spills to migrating bowhead whales could occur, although normal migration would tend to keep the whales offshore and away from nearshore barge traffic, and fuel resupply by barge is not expected to be the preferred scenario.

b. Effects on Subsistence Species:

(1) Terrestrial Mammals:

(a) Effects of Disturbance: For oil and gas activities, effects of Alternative D are expected to be significantly greater than those of Alternative B, with more helicopter disturbance of caribou and other terrestrial mammals. Increased habitat alteration would include the development of one to four oilfields and a pipeline to TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed near the pipeline during periods of air traffic. Surface, air, and foot traffic near the oilfields is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. If a field is developed in the area south and west of Teshekpuk Lake, some TLH caribou calving is expected to be displaced within 1.86 to 2.48 mi (3-4 km) of roads and other production facilities over the life of the project (Secs. IV.C.9 and IV.E.9).

(b) Effects of Spills: The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 to 2 years (Secs. IV.C.9 and IV.E.9).

(2) Fish:

(a) Effects of Disturbance: The individual effects of actions related to oil and gas development are the same for Alternative D as for Alternative B. However, the likelihood of their occurrence is estimated to be roughly four to five times higher for Alternative D than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effects of drill pad, road, airstrip, and pipeline construction on arctic fish populations in Alternative D over those of Alternative B. Effects on fish resources from seismic and construction disturbance would increase under this alternative with increased chronic, short-term impacts on the subsistence fisheries of Barrow and Nuiqsut; Atqasuk's subsistence fishery does not quite reach the western edge of the planning area. Seismic surveys associated with Alternative E are expected to have the same overall effect on arctic fish as discussed for Alternative B (Secs. IV.C.7 and IV.E.7). Effects on fish resources from seismic and construction disturbance would increase under this alternative with increased chronic, short-term impacts on the subsistence fisheries of Barrow and Nuiqsut; Atqasuk's subsistence fishery does not quite reach the western edge of the planning area.

(b) Effects of Spills: Oil spills associated with Alternative D are expected to have the same overall effect on arctic fish as discussed for Alternative B (Secs. IV.C.7 and IV.E.7).

(3) Birds:

(a) Effects of Disturbance: Under Alternative D, most disturbance effects associated with ground transport, seismic surveys, exploratory drilling, construction in winter, and moderate flight frequency supporting large and small camps and aerial surveys, moderate increases of boat traffic on the Colville River, air transport of recreational parties, development well drilling, and spill-cleanup activities in summer are expected to be localized to within several hundred yards to 1 mi of the disturbing activity and temporary, ranging from brief (<1 day) in the case of response to a few aircraft flights or presence of ground or boat activity to 3 months or more for well drilling or ground-transport operations. Recovery in these instances is expected to require no more than 1 year. More intense activity, such as substantially increased boat or foot traffic along rivers, still is expected to require no more than one season for recovery for most species (Secs. IV.C.8 and IV.E.8).

Overall disturbance effects to important subsistence species of feeding, molting, and nesting white-fronted geese, black brant, eiders, oldsquaw, and other species are expected to be localized (within 100 yards to 0.6 mi of the activity) and temporary (ranging from <1 day for aircraft flight to 3 months for well drilling and ground operations). Recovery in these instances is expected to require no more than 1 year.

(b) Effects of Spills: Oil or fuel spills entering lakes with staging waterfowl populations are expected to require no more than one season for recovery for most species (Secs. IV.C.8 and IV.E.8).

(4) Bowhead Whales:

(a) Effects of Disturbance: The potential effects on bowhead whales from discharges and noise and disturbance are expected to be essentially the same under this alternative as under Alternative B (Secs. IV.C.10 and IV.E.10).

(b) Effects of Oil Spills: The potential effects on bowhead whales from oil spills are expected to be essentially the same under this alternative as under Alternative B (Secs. IV.C.10 and IV.E.10).

(5) Other Marine Mammals:

(a) Effects of Disturbance: The effects of oil and gas activities for Alternative D are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects are expected to occur in the Colville River delta-southern Harrison Bay area (Secs. IV.C.9 and IV.E.9).

(b) Effects of Spills: Small, onshore crude- and fuel- oil spills associated with Alternative D are not expected to reach the marine environment and affect marine mammals (Secs. IV.C.9 and IV.E.9).

436

c. Effects on Communities: Effects on Barrow, Atqasuk, and Nuiqsut from oil-industry-development disturbance are discussed in detail in Section IV.B.10 of the Beaufort Sea Sale 170 FEIS (USDOI, MMS, In prep.). See previous discussions in this section of effects on the primary subsistence species: caribou (and other terrestrial mammals), fish, birds, bowhead whales, and other marine mammals. Effects assessments from these sections are summarized below; for a synthesis of traditional knowledge (where available), see effects discussion for Subsistence under Alternative B (Sec.IV.C.13.).

(1) Barrow, Atqasuk, and Nuiqsut—Effects from Disturbance and Spills: Ongoing short-term, localized impacts from disturbance and oil spills would increase under Alternative D. Caribou could experience increased habitat alteration and some CAH and TLH caribou would experience disturbance and delays in their movements. Caribou displacement would increase near oilfields, but there would be no significant effects to caribou populations. Fatalities and health effects from oil spills are expected to impact only a small number of terrestrial mammals and birds, with recovery in 1 to 2 years. Increased effects to the TLH and CAH, other terrestrial mammals, fish, birds, and other marine mammals harvested by subsistence hunters from these three communities are not expected to have increased effects on these overall subsistence harvests. No increases in effects are expected to bowhead whales. Under Alternative D, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be addressed by inplace stipulations.

Under this alternative,BLM would determine that the Federal portion of the Colville River to be eligible as a "recreational" river in the WSR System. If Congress eventually added the river to the system, BLM would develop a management plan to identify its management practices for the river. One issue that would be addressed in the plan would be whether motorized travel would be allowed on the river. A decision not to allow motorized travel could reduce the use of the river for subsistence

(2) Other Communities—Effects from Disturbance and Spills: Other communities within or adjacent to the NPR-A are the Chukchi Sea villages of Point Lay and Wainwright to the west and the inland community of Anaktuvuk Pass to the south and east. Subsistence-harvest areas for these communities are not within or adjacent to the planning area, although recent research indicates that movement by the TLH does bring the herd into the traditional subsistence-harvest areas of the communities of Wainwright and Point Lay. Historically, Anaktuvuk Pass caribou hunters have ranged to the southerly boundary of the planning area, and movement by the TLH would bring it into the harvest area of Anaktuvuk Pass subsistence hunters as well, although they primarily hunt the WAH (and to a lesser extent the CAH). Short-term and localized impacts from disturbance and oil spills to the TLH and CAH would have no apparent impact on subsistence-caribou harvests for these three communities. Stipulations specific to this alternative further would minimize impacts to caribou.

Conclusion—First Sale: Overall effects associated with Alternative D on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative B. Subsistence resources would be chronically impacted, but no resource would become unavailable, undesirable for use, or experience overall population reductions, resulting in no significant impacts to overall subsistence harvests and harvest patterns.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative D increases from a range of 185 to 825 MMbbl in one to four oil fields to a range of 370 to 1650 MMbbl in two to seven oil fields. The number of exploration wells increases from a maximum of 11 to 44, delineation wells increase from a maximum of 17 to 36, and production wells increase from a maximum of 248 on 6 pads to 495 on 12 pads. Pipeline miles increase from 105 to 150 mi. Multiple sales would occur over a longer period of time and, depending on frequency of sales, the timeframe for oil and gas activities in the planning area would extend to at least 2 decades.

For Alternative D, it is estimated that the number of spills <1 bbl would increase from a range of 28 to 123 spills to a range of 56 to 246 spills, and the number of spills >1 bbl would increase from a range of 9 to 41 spills to a range of 17 to 82 spills over the assumed production life of the planning area. The estimated number of crude oil spills over the assumed production life of the planning area would increase from a range of 37 to 164 spills to a range of 74 to 328 spills.

Effects of oil and gas activities under multiple sales are expected to increase over those for Alternative D with one sale. An increased potential displacement of calving TLH caribou along roads between the increased number of production pads and other facilities south of Teshekpuk Lake is expected. An increase in the number or miles of roads and other facilities with development under multiple sales is also expected to increase the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake. The displacement of calving caribou represents a functional loss of habitat within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oil fields and may reduce productivity and abundance of the TLH. Small, chronic oil spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative D with one sale but with loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations. Effects to arctic fish populations from additional sales from increases in the number of gravel pads are likely to have about twice the effect on arctic fish as discussed for Alternative D. Also, because the number of pipeline miles for multiple sales and Alternative D are similar, they are expected to have a similar effect as discussed for Alternative D. It is assumed that each additional lease sale would be expected to have similar effects on arctic fish as described for Alternative D. However, if there were not enough time between sales to allow for full recovery, or if the level of activity for the selected alternative was greater than that of Alternative D, the effects of each additional sale on arctic fish are likely to be greater than those for Alternative D. An increase in effects to bird populations from increased noise disturbance could be expected with multiple sales, with corresponding increases in disturbance and local displacement, but recovery in these instances is still expected to require no more than 1 year. Oil spills entering larger lakes with larger numbers of molting or broodrearing geese and other species may result in losses in the hundreds, requiring several breeding seasons for recovery. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. If several lease sales occur under Alternative D, considerably more exploration activity is expected to occur along the coast of the Colville River delta-southern Harrison Bay area. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects on polar bears and seals is expected to occur in the Colville River delta-southern Harrison Bay area. This increased activity could result in an increase in aircraft disturbance of seals hauled out on the ice along the coast in Harrison Bay and the Colville delta. An increase in onshore surface traffic activity (seismic exploration, overland moves, construction activities along the coast) could result in more disturbance of polar bears denning and foraging along the coast. However, these effects are expected to be local and short term, with no significant adverse effects to the polar bear and seal populations as a whole.

Conclusion—Multiple Sales: Effects from multiple sales under Alternative D are expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads assumed to be built between production pads south of Teshekpuk Lake. This effect is expected to persist over the life of the oil fields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Based on the assumptions discussed in the text, each additional lease sale is expected to have similar effects on arctic fish as described for Alternative D. However, if there are increased levels of activity associated with future lease sales, and or insufficient recovery time between sales, greater adverse effects than described for Alternative D are likely to occur. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. Effects to marine mammal populations as a whole from multiple sales under Alternative D are expected to be similar to those under Alternative D with one sale—local and short term, with no significant adverse effects.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.E.7, Fish Resources, IV.E.8, Birds, IV.E.9, Mammals, and IV.E.10, Endangered and Threatened Species. The effectiveness of stipulations for protecting subsistence practices is the same as for Alternative B, most important of which being a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on the NPR-A.

14. Sociocultural Systems: This discussion is concerned with those communities that could be impacted by ground-management actions and oil and gas leasing in the planning area. These communities are Barrow, Atqasuk, and Nuiqsut. Under Alternative D, only the high-value Goose Molting Habitat LUEA would be made unavailable to oil and gas leasing, essentially making the Teshekpuk Lake Watershed, Spectacled Eider Nesting Concentration, Fish Habitat, and Teshekpuk Lake Caribou Habitat LUEA's available to oil and gas leasing (4.15 million acres would be available and .51 million would be unavailable to oil and gas leasing). The Colville River would be recommended as a "recreational" river in the WSR System and managed as such. Lease-specific stipulations to protect water quality; fish habitat; wetlands; caribou-calving, -migration, and insect-relief areas; and subsistence resources and access would be in place to minimize impacts to these resources.

Portions of the Colville River would remain available to oil and gas leasing, aboveground pipelines, and gravel extraction. Raptor, passerine, and moose areas on the Colville River and recreation and scenic areas would also be available (with certain restrictions) to oil and gas leasing and the siting of pipelines and roads. The BLM would recommend the Secretary of the Interior establish the Pik Dunes and the Ikpikpuk Paleontological Sites as special areas.

The primary aspects of the sociocultural systems covered in this analysis are (1) social organization and (2) cultural values, as described in Section III.C.3. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level, predominantly by industrial activities, increased population, increased employment, and effects on subsistence-harvest patterns associated with the sale. For a more in-depth discussion of the parameters for sociocultural effects analysis, see the discussion for Alternative B (Sec. IV.C.13).

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. Disturbance impacts from increased aircraft traffic associated with resource inventories and surveys to birds, caribou, moose, muskoxen, and other terrestrial mammals would cause brief disturbance reactions lasting from a few minutes up to an hour, potentially causing terrestrial mammals to avoid research, survey, and recreation camps during the 4- to 6-week field season. No overall increase is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area, even with this increased disturbance from aircraft flights. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil-exploration activities—seismic activity and exploration drilling—would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled (at Camp Lonely), and moved inland the following winter, and seismic surveys would continue on the NPR-A, if a leasing program occurs. Under Alternative D, 1 to 4 fields with a resource range of 185 to 825 MMbbl are estimated. Four to 11 exploration wells would be drilled. For development, 5 to 17 delineation and from 56 to 248 production and service wells would be drilled, as well as from 80 to 105 mi of pipeline constructed.

(a) Disturbance from Exploration and Development: Sources for disturbance from exploration and development would be essentially the same as those discussed for Alternative B (Sec. IV.C.14, Sociocultural Systems).

(b) Spills and Spill Cleanup: See Section IV.E.13., Subsistence, for a discussion of Alternative D oil spills.

b. Population and Employment: Under Alternative D, oil and gas leasing in the planning area is projected to affect the population of the NSB through two types of effects on regional employment: (1) more petroleum-industry-related jobs as a consequence of NPR-A exploration and development and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (Sec. IV.B.11.). Employment projections as a consequence of NPR-A activities are provided in Section IV.C.11. Throughout the development and production phase, total petroleum-related employment would range from 1,318 to 3,270 jobs during the peak development and production years between 2006 and 2011. Resident employment as a result of NPR-A activities would peak at 46 to 77 jobs during the peak years 2006 and 2007. Most workers are expected to permanently reside outside of the North Slope. The NPR-A oil and gas activities are projected to increase resident employment 3 to 5 percent during the development phase and 1 to 4 percent during the production phase above the declining existing-condition projections between 2000 and 2015 (Tables IV.E.11-1 and IV.E.11-2). The NPR-A development under Alternative D is projected to increase the NSB population above the existing-condition level.

c. Subsistence-Harvest Patterns: Effects could be expected on subsistence-harvest patterns in the planning area as a result of disturbance to Barrow, Atqasuk, and Nuiqsut's subsistence harvests due to seismic disturbance, aircraft noise, supply vessel traffic, onshore-construction, and oil spills (see discussion for Alternative B, Sec. IV.C.13).

d. Effects on Barrow, Atqasuk, and Nuiqsut: This section analyzes effects of industrial activities, population and employment changes, and subsistence-harvest-pattern impacts on North Slope social organization, cultural values, and other issues. This discussion focuses on the North Slope as a whole and with a discussion for each community.

(1) Social Organization: The social organization of communities that might be affected by oil and gas activities in the planning area includes typical features of Inupiat culture: kinship networks that organize much of a community's subsistence-harvest, consumption, and sharing activities; informally derived systems of respect and authority; strong extended families (although not always living in the same household); stratification between families focused on success in the subsistence harvest; and access to subsistence technology (Sec. III.C.2). However, activities generated by oil and gas activities in the planning area are not likely to bring about the effects to these features in the communities in question (see discussion for Alternative B, in Sec. IV.C.14).

(2) Cultural Values: Cultural values and orientations (as described in Sec. III.C.2) can be affected by changes in the population, social organization and demographic conditions, economy, and alterations of the subsistence cycle. Of these, the only changes that could be expected to occur would be in Nuiqsut's social organization and the subsistence cycle in Barrow, Atqasuk and Nuiqsut (see discussion for Alternative B, Secs. IV.C.13, IV.C.14, and IV.E.13).

Chronic, short-term, localized impacts from disturbance and oil spills would increase under Alternative D. Caribou could experience increased habitat alteration and some CAH and TLH caribou would experience disturbance and delays in their movements. Caribou displacement would increase near oilfields, but there would be no significant effects to caribou populations. Fatalities and health effects from oil spills are expected to impact only a small number of terrestrial mammals and birds with recovery in 1 to 2 years. Increased effects to the TLH and CAH, other terrestrial mammals, fish, birds, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters are not expected to have increased effects on the overall subsistence harvests for these communities. No increases in effects are expected to bowhead whales. Under Alternative D, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be addressed by inplace stipulations.

Overall effects associated with Alternative D on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative B. Subsistence resources would be chronically impacted, but no resource would become unavailable, undesirable for use, or experience overall population reductions, resulting in no significant impacts to overall subsistence harvests and harvest patterns. Short-term disruptions of subsistence-harvest activities would cause periodic disruption to institutions and sociocultural systems but likely would not displace existing institutions.

(3) Social Health: Effects on sociocultural systems often are evidenced in rising rates of mental illness, substance abuse, and violence. This has proven true for Alaskan Natives, who have been faced since the 1950's with increasing acculturative pressures. The rates of these occurrences far exceed those of other American populations such as Alaskan non-Natives, American Natives, and other American minority groups (see discussion for Alternative B, Sec. IV.C.13). Although there may be additional reasons for differences in social problems in local communities, it is clear that the proximity to industrial enclaves enables residents easier access to drugs and alcohol, thereby affecting the social health of the community—a situation that could intensify in Nuiqsut as a result of NPR-A oil and gas activity. Any effects on social health would have ramifications in the social organization, but NSB Native communities have, in fact, proven quite resilient to such effects by local voter insistence on these communities being "dry" and by the NSB's continued support of Inupiat cultural values and its strong commitment to health, social service, and other assistance programs.

Nuiqsut is the most likely community in the region to experience additional sale-related effects in social health and well-being. These effects on social health could have direct consequences on the sociocultural system but would not have a tendency toward displacement of existing institutions above the displacement that already has occurred with the current level of development. Effects on the institutions and sociocultural systems in Barrow and Atqasuk would be periodic but not displace existing institutions.

Conclusion—First Sale: Effects from management actions and oil and gas activities in the planning area under Alternative D are unlikely to disrupt sociocultural systems. Disturbance effects would be short term and would not be expected to disrupt or displace institutions and sociocultural systems, community activities and traditional practices for harvesting, sharing, and processing subsistence resources. Periodic disruptions to subsistence resources could occur, but any disruptions that could occur from oil and gas activities potentially would be mitigated by BLM inplace stipulations designed to protect caribou, waterfowl, fish, moose, and subsistence resources and harvest practices. Overall effects under Alternative D to the sociocultural systems of the communities of Barrow, Atqasuk, and Nuiqsut would increase over those in Alternative B, but there would continue to be no disruption or displacement of cultural institutions or sociocultural systems.

Multiple Sales: If several lease sales occur under Alternative D, considerably more exploration activity is expected to occur in the planning area, and the levels of effects due to noise, disturbance, and habitat alteration are expected to increase. Given that resource estimates and development scenarios project an increase in resources and a large increase in the number of drill pads and pipeline miles, logic would assume a large increase in the effects to potentially affected subsistence resources, except for the fact that these effects would be spread over 2 decades. The critical factor would be the timing between sales—a longer interval would allow more recovery for subsistence resources from aircraft, vehicular, and construction disturbance and for subsistence practices from increased access conflicts; less of an interval might not allow for sufficient recovery. In any case, the cumulative effect clearly would be an increased development "footprint" and consequent increased habitat loss to resources and use loss to hunters. This could affect subsistence harvests in the communities of Barrow, Atqasuk, and (especially) Nuiqsut and could alter caribou distributions sufficiently to make subsistence-hunter access more difficult.

Conclusion—Multiple Sales: Effects from management actions and oil and gas activities in the planning area for multiple sales under Alternative D could disrupt sociocultural systems for periods up to 1 year, but impacts would not be expected to displace institutions and sociocultural systems, community activities, or traditional practices for harvesting, sharing, and processing subsistence resources, the same level of effect anticipated for multiple sales under Alternative B.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.E.7, Fish Resources, IV.E.8, Birds, IV.E.9, Mammals, and IV.E.10, Endangered and Threatened Species. The effectiveness of stipulations for protecting subsistence practices and sociocultural systems is the same as for Alternative B, most important of which being a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on the NPR-A.

15. Coastal Zone Management: Under Alternative D, approximately 4.1 million acres (nearly 90% of the planning area) would be available for oil and gas leasing, including coastal areas near the Colville River delta and in southern Harrison Bay. The Goose Molting Habitat LUEA (one-half million acres) would not be available to oil and gas leasing and industrial development. Aboveground pipelines could cross all lands within the planning area, and all lands would be available for seismic studies. These areas are subject to restrictions for siting pipelines and industrial structures. The Colville River in the planning area would be recommended and managed as a "recreational" river in the WSR System. Other protections include adding a Bird Conservation Area along the Colville River; designating the Ikpikpuk Paleontological Sites LUEA as a new Special Area to protect paleontological resources; and adding the Pik Dunes LUEA to the Teshekpuk Lake Special Area.

Federal lands within the NPR-A are excluded from the coastal zone; however, all uses and activities on Federal lands either occurring within the coastal zone or that may reasonably be expected to affect the coastal area and its resources must be consistent to the maximum extent practicable with enforceable standards of the ACMP, including State standards in 6 AAC 80 and enforceable policies of local district programs. The enforceable policies of the NSB CMP have been incorporated within the zoning ordinance in Section 19.70.050. The primary goal of the NSB's LMR's and zoning ordinances is to protect the subsistence lifestyle of the Borough's largely Inupiat population while encouraging and managing economic development.

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions described under Alternative D would be similar to those under Alternative A. Although the level of activities such as resource inventories, aerial surveys, and research camps is expected to increase somewhat under Alternative D, the level of effects is expected to be about the same as Alternative A. Disturbance impacts from increased aircraft traffic associated with resource inventories and surveys to birds, caribou, moose, muskoxen, and other terrestrial mammals would cause brief disturbance reactions lasting from a few minutes up to an hour, potentially causing terrestrial mammals to avoid research, survey, and recreation camps during the 4- to 6-week field season. Activities along the coast that may affect marine mammals include aerial surveys (including wildlife surveys); ground activities such as resource inventories, paleontological excavations, research and recreation camps; and overland moves. Effects to marine mammals under Alternative D would be similar to those for Alternative A—local and short term, with no significant adverse effects to the populations as a whole. No overall increase is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area, even with these increased disturbances from aircraft flights.

b. Oil and Gas Exploration and Development Activities: Under Alternative D, the impacts from exploratory drilling and development activities are expected to be similar to, but with some increase over that of Alternative B, because the only area unavailable for leasing is the Goose Molting Habitat LUEA. Oil-exploration activities, including seismic survey activity and exploration drilling, would occur in winter (early December-mid-April). Construction materials (and gravel for pads), personnel, and fuel would be transported over winter ice roads using low-ground-pressure vehicles from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment could be barged to coastal staging areas in the summer and moved inland the following winter. Seismic surveys would continue on the NPR-A. Under Alternative D, 1 to 4 fields with a resource range of 185 to 825 MMbbl of oil are estimated. Four to 11 exploration wells would be drilled. For development, 5 to 17 delineation and from 56 to 248 production and service wells would be drilled, as well as from 80 to 105 mi of pipeline constructed.

Effects of Exploration and Development on the Alaska CMP: Potential conflict with coastal management standards under Alternative D may arise under the habitat, subsistence, and water- quality standards of the ACMP. Sources for disturbance from oil and gas exploration and development activities essentially would be the same as those discussed for Alternative B, except for possible barge-resupply traffic. Chronic, short-term, localized impacts from disturbance and oil spills would increase under Alternative D.

Increases in effects of disturbance from barge-resupply traffic along the coast may affect marine mammals, due to noise and disturbance from air and surface traffic, and seismic survey activities. Projected summer supply barge traffic in open water could result in potential impacts from noise and fuel spills to migrating bowhead whales, although normal migration would tend to keep whales offshore and away from near shore barge traffic. Six species of marine mammals —ringed, spotted, and bearded seals; walruses; polar bears; and belukha whales—commonly occur year-round or seasonally in coastal habitats adjacent to the planning area. Under Alternative D, some individual members of these species may be exposed to effects from oil and gas exploration and development as well as other activities.

Effects on fish resources from seismic surveys and construction disturbance would increase under this alternative with increased chronic, short-term impacts on the subsistence fisheries of Barrow and Nuiqsut. Atqasuk's subsistence fishery does not extend to the western edge of the planning area. Seismic surveys associated with Alternative D are expected to have the same overall effect on arctic fish as discussed for Alternative B (Secs. IV.C.7 and IV.E.7). All NPR-A scenarios call for an onshore pipeline for oil delivery to TAPS, and there is a potential for a pipeline spill contaminating the Colville River. However, estimating the chance of this occurring is uncertain at this time. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail substantial hunting as resources may be tainted, or even the perception of tainting substantially would affect the subsistence harvest (Secs. III-B.5, Marine Mammals, and IV.C.13, Subsistence).

Chronic, short-term, localized impacts to local communities, including Nuiqsut, Barrow, and Atqasuk, from disturbance and oil spills would increase under Alternative D. Effects of more helicopter disturbance to caribou and other terrestrial mammals are expected to be significantly greater than those of Alternative B. Caribou could experience increased habitat alteration and some CAH and TLH caribou would experience disturbance and delays in their movements. Caribou displacement would increase near oil fields but there would be no significant effects to caribou populations. Fatalities and health effects from oil spills are expected to impact only a small number of terrestrial mammals and birds with recovery in 1 to 2 years. Increased effects to the TLH and CAH, other terrestrial mammals, fish, birds, and other marine mammals harvested by Nuiqsut subsistence hunters are not expected to have increased effects on Nuiqsut's overall subsistence harvest. No increases in effects are expected to bowhead whales.

Potential conflict between Alternative D proposed activities and Statewide standards and NSB district policies could occur in conjunction with the NSB CMP 2.4.5.2(h) (NSBMC 19.70.050.K.8) that relates to both subsistence and cultural resource areas. This policy requires that development be located, designed, and maintained so as not to interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence-use areas. Also, conflict with district policies may arise in the potential for adverse effects to subsistence resources. NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) relates to "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems." Potential conflicts with these standards is anticipated, but effects will be minimized by stipulations developed for this lease sale.

Conclusion—First Sale: Potential conflict with the habitat and subsistence standards of the ACMP is anticipated. Overall effects of oil and gas activities for Alternative D are expected to increase effects to terrestrial mammals, marine mammals, and subsistence resources and activities of local communities, over the effects of Alternative B. Although most of the increase in human activities is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects to marine mammals other than bowhead whales are expected to occur in the Colville River Delta-southern Harrison Bay area. The CAH and TLH caribou herds are expected to be disturbed and their movements delayed near the pipeline during periods of air traffic. Surface, air, and foot traffic near oilfields is expected to increase and to displace some terrestrial mammals, but not significantly affect the Arctic Slope populations. If a field is developed in the area south and west of Teshekpuk Lake, some TLH caribou is expected to be displaced within 3 to 4 kilometers of roads and other production facilities over the life of the project. Subsistence resources would be impacted, but no resource would become unavailable, undesirable for use, or experience overall population reductions, resulting in no significant impacts to overall subsistence harvests and harvest patterns.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative D increases from a range of 185 to 825 MMbbl in one to four oilfields to a range of 370 to 1,650 MMbbl in two to seven oilfields. The number of exploration wells increases from a maximum of 11 to 44, delineation wells increase from a maximum of 17 to 36, and production wells increase from a maximum of 248 on 6 pads to 495 on 12 pads. Pipeline miles increase from 105 to 150 mi. Multiple sales would occur over a longer period of time and, depending on frequency of sales, the timeframe for oil and gas activities in the planning area would extend to at least 2 decades.

Effects of oil and gas activities under multiple sales are expected to increase over those for one sale under Alternative D and may result in potential conflict with the habitat and subsistence standards of the ACMP. An increased potential displacement of calving TLH caribou along roads from increased production pads and other facilities and miles of roads south of Teshekpuk Lake is expected. The displacement of calving caribou represents a functional loss of habitat within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH. Small, chronic oil spills are expected to have generally the same effect on terrestrial mammals and their habitats for multiple sales as for one sale under Alternative D, except that spills and habitat contamination may account for loss of individual mammals , particularly at the spill sites and along any streams contaminated by oil spills. Loss of small numbers of terrestrial mammals are expected, with recovery expected within 1 year (Sec. IV.C.9).

Effects on arctic fish populations from additional sales due to increases in the number of gravel pads are likely to have about twice the effect on arctic fish in the single-sale scenario as discussed for Alternative D. Each additional lease sale would be expected to have similar effects on arctic fish as described for a single sale under Alternative D. However, if there was insufficient time between sales to allow for full recovery on arctic fish, or if activity levels for the selected alternative were greater than assumed under Alternative D, the effects of each additional sale on arctic fish are likely to be greater than those for Alternative D. Increases in effects to bird populations from increased noise disturbance and local displacement could be expected with multiple sales over one sale under Alternative D, but recovery in these instances is still expected to require no more than 1 year.

The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. If several lease sales occur under Alternative D, considerably more exploration activity is expected to occur along the coast of the Colville River delta-southern Harrison Bay area. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects on polar bears and seals is expected to occur in the Colville River delta-southern Harrison Bay area. This increased activity could result in an increase in aircraft disturbance of seals hauled out on the ice along the coast in Harrison Bay and the Colville delta. An increase in onshore surface traffic activity (e.g., seismic exploration, overland moves, and construction activities along the coast) could result in more disturbance of polar bears denning and foraging along the coast. However, these effects are expected to be local and short term, with no significant adverse effects to the polar bear and seal populations as a whole.

Conclusion—Multiple Sales: Effects from multiple sales under Alternative D may result in potential conflict with the habitat and subsistence standards of the ACMP. Multiple-sales effects under alternative D are expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads assumed to be built between production pads south of Teshekpuk Lake. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. Small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Based on the assumptions discussed in the text, each additional lease sale is expected to have similar effects on arctic fish as described for Alternative D. However, if there are increased levels of activity associated with future lease sales, and/or insufficient recovery time between sales, greater adverse effects than described for Alternative D are likely to occur. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. Effects to marine mammal populations as a whole from multiple sales under Alternative D are expected to be similar to those with one sale—local and short term, with no significant adverse effects. Under Alternative D, it is expected that protections for birds, fish, waterfowl, and terrestrial mammals, water quality, and subsistence-hunter concerns about access to resources and resource contamination would be addressed by stipulations.

Effectiveness of Stipulations: Stipulations described in Section II.C.7 were developed to provide maximum protection to all high-value resources within the NPR-A, particularly in areas available to oil and gas leasing. These special stipulations are expected to provide protections to the wildlife and habitat resources within the NPR-A. Application of these measures reduces the potential for conflicts with the standards of the Alaska CMP.

Lease-specific stipulations to protect water quality; fish habitat; wetlands; caribou-calving, caribou-migration, and caribou insect relief areas; and subsistence resources and access would be in place to minimize impacts to these resources. Stipulations regarding solid- and liquid-waste disposal, fuel handling, and spill cleanup are expected to reduce the potential effects of spills and human refuse on terrestrial mammals. Stipulations on overland moves and seismic work are expected to minimize alteration of terrestrial mammal habitats. The stipulation requiring aircraft maintain a 1,000 ft AGL (except for takeoffs and landings) over caribou winter ranges from October through May 15, and to maintain 2,000 ft AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, is expected to minimize disturbance of caribou.

The stipulations related to oil and gas exploration and development, including facility design and construction restrictions, are expected to minimize alteration of terrestrial-mammal habitat and interference with caribou movements. Stipulations requiring elevated pipelines and roads to be separated at least 500 ft and to place pipelines on the appropriate side of the road (depending on general movements of caribou in the area) could significantly reduce interference with caribou movements.

Several stipulations were developed to provide protection for birds. For example, disturbance of birds from ground transportation and other activities including oil and gas activities would be mitigated, and essential habitat protected by Stipulations 20b through m, minimizing and seasonally restricting vehicle use and seismic activity, and taking recommended precautions in Colville River LUEA (geese, raptors, and passerines affected). Stipulations 31 and 25 require avoidance of lakeshore margins for oil and gas activities, avoidance of lake margins, and establish a facility buffer around high-use lakes (geese, shorebirds). Stipulation 32 requires consolidation/integration of oil and gas facilities, and incorporate visual screening features for facilities near goose-molting lakes (geese). Stipulations 38, 39, and 44 establish facility setbacks along specified lakes and streams, facilities and mining sites located out of floodplains and 500 ft from lake basins, and no long-term occupancy of the Colville River LUEA (raptors, passerines, loons, broodrearing waterfowl). Aircraft disturbance of birds would be mitigated by Stipulations 56 and 57, maintenance of seasonal minimum flight altitudes over the Teshekpuk Lake and Colville LUEA's (loons, geese, shorebirds, raptors, passerines). Other potentially adverse situations would be mitigated by Stipulations 7 and 10, immediate cleanup of fuel spills using ADEC-approved materials stored at all fueling and maintenance areas. Stipulation 11 requires fuels be stored in lined/diked areas at least 100 ft from lakes and streams (loons, waterfowl, shorebirds, passerines), preparing a hazardous materials contingency plan for large fuel transport (loons, geese, shorebirds); Stipulation 18 restricts removing quantities of water from lakes that do not alter the lakes used by molting geese (geese, loons, shorebirds); Stipulation 1, taking precautions to avoid attracting wildlife (predators) to refuse; Stipulation 70 prohibits public access to the Goose Molting LUEA through oilfields (geese, loons, shorebirds, passerine); and Stipulation 59, removal of gravel fill so as to prevent enhanced access to the Goose Molting LUEA (geese, loons). These stipulations would minimize disturbance from most factors and prevent fuel or oil spilled on pads from reaching surrounding habitats.

The effectiveness of stipulations for protecting bowhead whales and other endangered species from noise and disturbance from oil and gas activities are the same as for Alternative B, and from activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, the same as Alternative A. For marine mammals, the effectiveness of stipulations is expected to be the same as under Alternative A. Lease-specific stipulations to protect water quality; fish habitat; wetlands; caribou-calving - migration, and insect-relief areas; and subsistence resources and access would be in place to minimize impacts to these resources in the Colville River.

The effectiveness of stipulations described above for protecting biological resources and habitat and for subsistence activities would reduce potential conflicts with the habitat and subsistence standards of the ACMP and NSB CMP policies.

16. Recreation and Visual Resources:

a. Activities Other than Oil and Gas Exploration and Development:

Disturbance: Activities other than oil and gas exploration and development expected under Alternative D are the same as under Alternative A. However, certain of these activities would increase as a result or in support of oil and gas development. For example, field activities associated with archeological site clearances, such as camps, excavations, and aircraft activity all likely would increase. Impacts would be minimal and short term in nature, as described under Alternative A, but the total area impacted could increase to 3,000 acres (from 1,500 in Alternative A).

Although the amount of supplies and material transported by winter overland moves may increase under this alternative, these moves generally follow the same route. Therefore, neither the length nor number of green trails is expected to noticeably increase from Alternative A.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: The types of oil and gas exploration activities that occur under Alternative D are similar to those under Alternative B. However, the level of some of these exploration activities would increase as compared to Alternative B, i.e., additional seismic-survey operations are expected, the number of exploration/delineation wells drilled at any one time would increase from 1 to 4 , and the total number of these wells would increase from 10 to 28. Consequently, short-term impacts from ongoing seismic activity could increase from 500 acres affected under Alternative A and 1,000 acres under Alternative B to 1,500 to 2,000 acres affected under Alternative D. The area that could be impacted during drilling operations would increase from approximately 8,000 acres to 32,000 acres (winter only). Accumulating summer-season visual impacts from the greening of ice pads, roads, and airstrips would increase from about 500 acres (under Alternative B) to 1,400 acres. Several hundred miles of lineal green trails also would be visible from the air as a result of seismic operations; the number of miles visible would increase from Alternative B in direct relationship to increased seismic operations.

(2) Development: The types of oil and gas development activities that occur under Alternative D are similar to those under Alternative B. However, the number of production pads is anticipated to increase from two (under Alternative B) to six, and the number of miles of pipeline is expected to increase from 75 mi (under Alternative B) to 105 mi. Under Alternative D, the number of pump stations will remain the same as under Alternative B (one). Consequently under this alternative, there would be a long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 123,000 acres (i.e., [8,000 acres/pad x 6 pads] + [8,000 acres/pump station x 1 pump station] + [640 acres/mi x 105 mi of pipeline]). This is about 41,000 acres more than under Alternative B.

Effects of Spills: The effects of spills would be the same as analyzed for Alternative B.

Impacts to Wild and Scenic River Values: Under this alternative, resources on Federal lands and waters on and along the Colville River would receive the protection of a "recreational river" as afforded by the WSR Act (Appendix G). As such, certain development not allowed in the designated river corridor under Alternative B would be allowed under this alternative. However, management priorities for a "recreational river" still require that outstandingly remarkable river values be protected. Therefore, while developments such as pipelines and roads would be allowed to cross or access the river, these developments would be designed to minimize or avoid impacts to outstandingly remarkable river values. Pipelines and roads could access and parallel the river but, through design and perhaps location restrictions, the impacts to identified outstandingly remarkable values would be minimized. Under this alternative, the potential impacts to outstandingly remarkable values on Federal lands and waters is greater than under alternative C, but nevertheless minimal. State and private lands and resources on and along the designated portion of the Colville would not be under Federal management or protection.

Conclusion—First Sale: As compared to Alternative A, there would be an increase of approximately 1,500 acres to 3,000 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. As compared to Alternative B, short-term impacts from ongoing oil and gas exploration activities would increase from approximately 9,000 acres to 33,500 to 34,000 acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would increase to about 1,400 acres, a 900-acre increase from Alternative B. Seismic operations would result in several hundred miles of green trails with likely increases over Alternative B directly corresponding to increases in seismic operations.

Oil and gas development would result in the long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 123,000 acres (or 2.5% of the planning area) for the life of production fields and pipelines. This is 41,000 acres more than under Alternative B.

Multiple Sales: The types of impacts resulting from additional lease sales would be the same as described above for a single sale. Short-term impacts such as green trails and disturbance resulting from noise, aircraft, and other ongoing activities would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would accumulate to the extent such facilities are necessary to support additional exploration and production. It is anticipated that such facilities would increase about 67 percent over that needed for the first sale and affect a total of approximately 192,000 acres.

Conclusion—Multiple Sales: Long-term impacts would accumulate and increase about 67 percent above those of the first sale, ultimately affecting approximately 192,000 acres or about 4.2 percent of the planning area.

Effectiveness of Stipulations: The Upper Colville River upstream from about Umiat would be designated Visual Management Class II under this alternative. As such, no permanent visible structures would be allowed in this important recreation and scenic Class A area. The Colville River from about Umiat to Ocean Point, a scenic Class B area and also an important recreation area, would be managed as a Visual Management Class III area. Under Class III guidelines, construction may be visible but should not dominate the landscape. Mitigation required to meet the standards established by these management classes should prevent any significant long-term impacts to visual/recreation values in these two highly scenic and important recreation areas.

Under this alternative, the Kuukpik and Intensive Subsistence LUEA's would be managed as Visual Management Class IV areas rather than Class III areas, as under Alternative B. Under Class IV guidelines, construction may dominate the landscape in terms of scale. This would result in less aggressive efforts to mitigate visual impacts. An aboveground pipeline through this area may exceed Class III standards.

The remaining planning area is designated Visual Management Class IV, the same as under Alternative B.

As under other alternatives, impacts to recreation values from exploratory oil and gas activities and from overland moves are significantly reduced by restricting these activities to winter months. Few recreationists visit the area during winter months.

BLANK PAGE

F. ALTERNATIVE E: Alternative E would include BLM's management actions described for Alternative A and a proposal for making approximately 4.6 million acres in the Northeast NPR-A Planning Area available to oil and gas leasing. Protection of the resources is to be achieved by establishing stipulations (Sec. II.C.7) consistent with technically and economically feasible development and by granting enhanced recognition to some resources; the status of the LUEA's for oil and gas leasing under Alternative E is show in Table IV.F-1. Seismic activities would be permitted throughout the planning area. In addition, the alternative includes (1) establishing a Bird Conservation Area that would incorporate part of Colville River valley, (2) creating a Special Area designated by the Secretary of the Interior along the Ikpikpuk River to protect paleontological resources, and (3) adding the Pik Dunes LUEA to the Teshekpuk Lake Special Area.

The types of activities that might impact the resources include those noted for Alternative A and those additional activities associated with oil and gas exploration and development as noted for Alternative B. The level of activities other than oil and gas would be similar to or slightly greater for Alternative E than for Alternative A (Table IV.A.1.a-1). The economically recoverable oil resources for the first oil and gas lease sale are estimated to range from 250 to 1,100 MMbbl (Table IV.A.1.b-4). The oil resources estimated for Alternative E are greater than those estimated for Alternative B (Table IV.A.1.b-4), and thus the levels of activities associated with Alternative E also are estimated to be greater than they are for Alternative B. These activities include drilling 11 to 38 exploration and delineation wells, constructing two to nine production pads, drilling 75 to 330 production and service wells, and constructing 80 to 205 mi of pipeline (Table IV.A.1.b-5). If the area available for oil and gas leasing under Alternative B results in multiple sales, 500 to 2,200 MMbbl of oil are estimated to be recovered (Table IV.A.b.1-6). The types of activities associated with multiple sales would be similar to those that might occur as the result of the first sale. The level of activities for multiple sales is shown in Table IV.A.1.b-7.

1. Soils: The types of activities that may affect soils under Alternative E include those analyzed under Alternatives A and B.

a. Activities Other than Oil and Gas Exploration and Development: The effects of management actions described under Alternative E are similar to Alternative A, except there may be an increase in excavations (Sec. IV.F.6).

b. Oil and Gas Exploration and Development Activities: Under Alternative E, the impacts from exploratory drilling and development activities would be the same as under Alternative B, except there would be an increase in the estimated level of activities. These activities could result in an estimated permanent loss of soils (based on loss of vegetation, as noted in Sec. IV.F.6).

Table IV.F-1
Land Use Emphasis Areas Status for Oil and Gas Leasing Under Alternative E[1]

Land Use Emphasis Area	Fig. No. II.B.	Oil and Gas Leasing Status
Teshekpuk Lake Watershed	1	Available
Goose Molting Habitat	2	Available
Spectacled Eider Nesting Concentrations	3	Available
Teshekpuk Lake Caribou Habitat	4	Available
Fish Habitat	5	Available
Colville River Raptor, Passerine, and Moose Area	6	Available
Umiat Recreation Site	8	Available
Scenic Areas	9	Available
Pik Dunes	10	Available
Ikpikpuk Paleontological Sites	11	Available
Kuukpik Corporation Entitlement	13	Available
Potential Colville Wild and Scenic River	14	Available

[1] Section II.

impacts to soils from spills and spill cleanup, based on the impacts to vegetation (Sec. IV.F.6).

Conclusion—First Sale: Estimated areas of impacts and losses of soils from all activities are similar to those areas discussed under vegetation (Sec. IV.F.6).

Multiple Sales: Additional lease sales under Alternative E would result in additional exploration and development activities. The area of impacted soils is closely related to that of the disturbed vegetation (see Vegetation, Sec. IV.F.6, for acreage details).

Conclusion—Multiple Sales: Areas of impacts and losses of soils from all activities in multiple sales are similarto those areas discussed under vegetation (Sec. IV.F.6).

Effectiveness of Stipulations: There are no stipulations beyond those identified in Section II.C.7 that could reduce the impacts to soils.

2. Paleontological Resources:

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Paleontological resources (plant and animal fossils) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative E, the management-action impacts generally are the same as under Alternative A, except the intensity of the actions would increase due to potential oil and gas exploration.

(2) Oil and Gas Exploration and Development Activities: Paleontological resources are not ubiquitous in the planning area as are wildlife and habitat, and their occurrence is much less predictable. As a result, it is quite possible that no oil and gas exploration or development activities would impact a paleontological resources site. However, as the area open to exploration and development increases, as it does dramatically in Alternative E, the possibility of no impacts to paleontological resources decreases markedly.

(a) Effects of Disturbance from Exploration: The types of oil and gas exploration activities that would occur under Alternative E would be the same as those that would occur under Alternative B. However, the level or intensity of these exploration activities would increase dramatically under Alternative E. The number of exploration/delineation wells drilled would increase from 10 in Alternative B to 38, and as many as 6 wells might be drilled in a single winter season. This would increase the probability of potential impact nearly 300 percent over Alternative B.

(b) Effects of Exploration Spills: These effects would be the same as those under Alternative B, except the possibility of impacts would be increased by almost 300 percent.

(c) Effects of Disturbance from Development: The types of oil and gas development activities that would occur under Alternative E would be the same as those that would occur under Alternative B. However, the level or intensity of these activities would increase under Alternative E. The number of production pads would increase from two in Alternative B to six in Alternative E, and pipeline miles would increase by 130 for a total of 205 mi under Alternative E. Although difficult to quantify, the potential for the construction of pump stations, causeways, docks, and seawater pipelines also increases under Alternative E. Although unlikely, it also is possible that a causeway and/or dock be constructed along the coast. The possibility of a seawater pipeline also exists at about the same order or probability. All this activity dramatically increases the probability of potential impacts to paleontological resources beyond that of Alternative B.

(d) Effects of Development Spills: These effects would be the same as under Alternative B, although the possibility of spills would be greatly increased.

Conclusion—First Sale: Alternative E opens all of the planning area to oil and gas leasing. Under Alternative E, impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature but may be significantly increased in magnitude over Alternative B.

Multiple Sales: The potential impacts to paleontological resources under Alternative E could increase by as much as 400 percent compared to Alternative B.

Conclusion—Multiple Sales: Under Alternative E, potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under Alternative E, the potential impacts to paleontological resources from oil and gas exploration and development would increase by at least 400 percent compared to Alternative B.

Effectiveness of Stipulations: The effectiveness of stipulations would be the same as under Alternative B.

3. Water Resources:

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may affect water resources under Alternative E would be similar to those under Alternative A, except that the number and frequency of camps and moves would increase slightly. The increase would depend on management actions in land, water, and resource monitoring as related to leasing activities. Because Alternative E emphasizes the least protection of surface resources, all of the areas adjacent to streams and lakes identified as critical aquatic habitat would be available to leasing. Therefore, many of the additional camps and moves likely would be near these critical aquatic habitat areas.

b. Oil and Gas Exploration and Development Activities:

(1) Disturbance: Exploration and development activities within the planning area that may affect water resources under Alternative E would be similar to those under Alternative B, except that the number and frequency of these activities would increase (Table IV.A.1.b-1). The increase would depend on the number of leases issued, the number of proposals for exploratory activity, and the locations of this activity. As noted previously (Sec. IV.F.3.a), some of the areas adjacent to streams and lakes identified as critical aquatic habitat would be available to leasing. Therefore, some of the additional exploration and development likely would be near these critical aquatic habitat areas. The likelihood of exploration and development activities occurring in an area that contains more water resources and critical aquatic habitat areas than Alternatives B, C, and D increases the risk of disturbing stream banks and shorelines, disrupting drainage patterns, increasing erosion and sedimentation, and removing water from riverine pools and lakes.

(2) Spills and Spill Cleanup: Under Alternative E, the potential number and extent of oil spills and cleanup would increase from those under Alternatives B and D (Sec. IV.A.2). Alternative E, because it includes more of the critical lake and river habitat than Alternatives B, C, and D, would have greater adverse effects on water resources as compared to Alternatives B, C, and D.

Conclusion—First Sale: The impacts of activities other than oil and gas exploration and development under Alternative E are expected to be similar to those under Alternative A (and similar to those under Alternatives B, C, and D). The potential long-term impacts (melting of permafrost and disrupting drainage patterns) and short-term impacts (increasing erosion and sedimentation and removing water from riverine pools and lakes) of oil and gas exploration and development on the water resources in the planning is expected to be greater for Alternative E than for Alternatives B, C, and D.

Multiple Sales: While the effects of oil and gas exploration and development from multiple lease sales may be up to several times greater than the first sale, impacts wold not necessarily go up proportionally. Shared use of infrastructure such as airfields, roads, camps, and pipelines could significantly reduce the size of the impacted areas and adverse effects to the water resources.

Conclusion—Multiple Sales: Shared infrastructure could reduce the adverse effects to water resources of multiple sales, in that combined facilities require less water for construction, maintenance, and camp use than separate, independent facilities.

Effectiveness of Stipulations: The measures that would be effective in minimizing potential effects of the ground-impacting-management actions on the water resources in the planning area for Alternative E would be the same as for Alternative B.

4. Water Quality:

a. Activities Other Than Oil and Gas Exploration and Development: As discussed under Alternative A, ground-impacting-management actions other than seismic operations and other oil and gas activities would not impact water quality.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Exploration activities within the planning area that may affect water quality under Alternative E are 2-D and 3-D seismic activity beyond that described under Alternative A, ice road construction, and pad construction, as found for Alternative B. Under Alternative E, total miles of seismic trails and resulting water degradation would be about twice that for Alternative A. That is, water quality could be degraded over a total of 1,800 acres.

For Alternative E, annual ice-pad and -road construction (330-840-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 120 to 320 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 4 to 8 acres of lake. Temporary upslope impoundment of snowmelt waters could cover another 80 acres. The areas affected would shift each year, as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

(2) Development: Development activities within the planning area that may affect water quality under Alternative E are ice-road and -pad construction and spills, as found for Alternative B.

Because of the continued need for ice roads, annual water use during development would be similar to that for exploration, requiring water from 120- to-310 acres' worth of intermediate-depth lakes to construct 320 to 820 acres of ice road. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet year for each field, requiring about 5 to 25 acres total of lake for water supply. Temporary upslope impoundment of snowmelt waters by ice roads could cover another 90 acres. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

The primary water quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or a total of 100 to 500 acres under Alternative E. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in up-slope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 200 to 1,000 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the field(s).

Spills are another impacting agent on water quality. A number of small crude spills averaging 4 bbl and smaller fuel spills averaging 0.7 bbl are projected to occur under Alternative E in fresh waters. Only about 8 percent of crude spills reasonably can be expected to reach tundra waters. For Alternative E, this calculation results in an estimate of 4 to 18 spills, each averaging 4 bbl, reaching tundra waters. Over the life of the fields, spills could affect the water quality of 4 to 18 ponds or small lakes, making their waters toxic to sensitive species for about 7 years.

With the high development in Alternative E, there is concern over the likelih[illegible] possible effects of a fuel barge spill. In addition, the oil-spill-risk analysis estimates a most likely number of zero to one spill >1,000 bbl along the TAPS tanker route for this alternative.

The discussions of oil spill effects on marine water quality, as contained in Sections IV.B.1 and IV.H.1 of the Sale 144 Final EIS (USDOI, MMS, 1996a), are herein incorporated by reference. A summary, supplemented by additional material, as cited, follows.

A fuel spill >1,000 bbl in the Beaufort Sea near the NPR-A in the open-water season should behave similarly to the 2440-bbl *Minuk I-53* spill of diesel fuel in the Canadian Beaufort Sea in 1985 (Birchard and Nancarrow, 1986). The spill extended over 3 mi^2 as slick the first day, 8 mi^2 as a slick the second day, and 50 mi^2 as thin sheen containing only about 50 bbl by the third day. Thus, by the third day of the spill, most of the fuel had either evaporated (38%) or dispersed into the water (58%). A fuel spill this size could temporarily contaminate Beaufort Sea waters over few tens of square miles to levels above chronic criteria but below acute criteria. However, the oil-spill-rate statistic for U.S. barges is only 4.32 spills >1,000 bbl per billion barrels of oil transported (Prentki and Anderson, 1995). Application of this spill rate to any reasonable or foreseeable estimate of NPR-A fuel barging results in a near-zero probability of a significant spill. Thus, a fuel spill is not anticipated to result or affect marine water quality under this alternative.

Tankering of oil under Alternative E is projected to result in a most likely number of zero to one spills >1,000 bbl along multiple TAP tanker routes. This spillage could individually contaminate receiving water over several tens of square miles to levels above chronic criteria but below acute criteria.

Conclusion—First Sale: Effects of oil and gas activities in Alternative E would be higher than in Alternative B. Effects of other activities would be similar to those in Alternative A. Long- term water quality over >3,000 acres could be affected by seismic trails, construction or placement of gravel roads, and other structures. Oil spills could result in waters of up to 18 ponds or small lakes remaining toxic to sensitive species for about 7 years. Tankering of oil is projected to result in a most likely number of zero to one spills >1,000 bbl along multiple TAPS tanker routes. Such a spill would contaminate receiving water over several tens of square miles to levels above chronic criteria but below acute criteria.

Multiple Sales: During peak exploration, annual ice-pad and -road construction (400-1,100-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 150 to 430 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 6 to 10 acres of lake. Temporary upslope impoundment of snowmelt waters could cover another 110 acres.

Because of the continued need for ice roads, annual water use during development for ice-road construction would be similar to that for exploration, requiring extraction of water

450

from 150 to 230 acres of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 10 to 40 acres of lake for water supply for all fields. Temporary up-slope impoundment of snowmelt waters by ice roads could cover another 110 acres.

The primary water-quality effect from construction and placement of gravel structures is related to up-slope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field air strip would cover about a 100-acre footprint per field, or a 200 to 800 acres total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 1,200 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields.

Over the life of development resulting from multiple sales, spills could degrade water quality of 8 to 36 ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years.

Significant marine spills are not anticipated offshore of NPR-A as a result of multiple sales in Alternative E. Multiple sales are projected to result in a most likely number of zero to two tanker spills >1,000 bbl along multiple TAPS tanker routes. This spillage could individually contaminate receiving water over several tens of square nautical miles to levels above chronic criteria but below acute criteria.

Conclusion—Multiple Sales: Longer term (decade-or-more) effects of multiple sales would be one-third greater than for a single sale. Oil spills could result in waters of up to 36 ponds or small lakes remaining toxic to sensitive species for about 7 years. The <2 most likely number of tanker spills along TAPS routes could individually contaminate receiving water over several tens of square nautical miles to levels above chronic criteria but below acute criteria.

Effectiveness of Stipulations: Effectiveness of stipulations is similar to that under Alternative B.

5. Air Quality:

a. Activities Other than Oil and Gas Exploration and Development: The ground-impacting-management activities that would affect air quality under Alternative E would be the same as those under Alternative A. The impacts of these activities would be the same as those under Alternative A.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Exploration activities within the planning area that may affect air quality under Alternative E are drilling and pad construction, the same as for Alternative D. For Alternative E, the number of exploratory wells drilled per year would be one to four wells more than under Alternative D.

(2) Development: Development activities within the planning area that may affect air quality under Alternative E are drilling, facility and pipeline construction, and production, the same as those under Alternative D. Total number of wells drilled for Alternative E would be approximately half again as many than alternative D. Total emissions from these activities would be limited through permits obtained from the State of Alaska to less than the Clean Air Act standards.

Conclusion—First Sale: Effects of oil and gas activities under Alternate E would be similar to those under Alternative D. Annually, air quality would be affected by drilling and construction activities at levels less than the PSD criteria. Effects of activities other than oil and gas would be negligible, the same as under Alternative A.

Multiple Sales: The effects on air quality from multiple sales should result in air emissions that remain below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected.

Conclusion—Multiple Sales: Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.

Effectiveness of Stipulations: Current laws and regulations are assumed to be in place for the analysis of the IAP, and effects levels reflect this assumption.

6. Vegetation:

Ground-impacting actions within the planning area that may affect vegetation under Alternative E include those analyzed under Alternative A and those resulting from oil exploration and development analyzed under Alternative B. The impacts of management actions described under Alternative A would be similar under Alternative E, except that the total areal extent of archaeological/paleontological excavations may increase to 6 acres per year and seismic-survey activity would increase (see below).

a. Exploration: Impacts of exploratory drilling under Alternative E would be of the same types as under Alternative B, but there would be 11 to 38 wells drilled rather than 1 to 10. This scenario could result in the death of vegetation on the perimeters of oversummer ice pads of 0.3 to 0.9 acres of vegetation spread among 6 to 19 different sites. Construction of well collars would cause the destruction of vegetation on 0.06 to 0.2 acres.

The types of impacts of seismic exploration would remain the same as under Alternative B. It is assumed that the number of 2-D surveys would remain the same at one per winter, but that this frequency would continue for about 15 years rather than 10 before decreasing to alternate winters. Because the tundra can recover from about 90 percent of these impacts in 9 years, it is expected that this change would result in little increase in area affected at any one point in time. It is also assumed that the number of 3-D surveys would increase from 0 to 2 over 5 years to 2 to 10 over 20 years. This would result in 92,000 to 460,000 acres impacted by 3-D surveys.

b. Development: The impacts of oilfield development would be of the same types under Alternatives B and E. The number of oilfields developed would increase from 0 to 1 under Alternative B to 1 to 5 under Alternative E, with a proportional increase in the extent of area impacted. The gravel pads of these oilfields would bury 100 to 500 acres of vegetation. Dust effects would cover 36 to 180 acres, and the effects of a changing moisture regime might affect 200 to 1,000 acres. The number of pump stations required would increase from 0-1 to 0-2, covering 0 to 80 acres of vegetation and indirectly affecting 0 to 120 acres more. Material sites would cause the destruction of 40 to 200 acres, with moisture-regime changes around them affecting another 20 to 100 acres. Flowline and sales-oil pipeline miles would increase, and it is assumed that a 15 mi seawater pipeline for waterflooding also would be necessary. This would cause the total vegetation impacts from all pipelines to increase to 3.0 to 7.4 acres. Finally, the occurrence of spills would increase, affecting 1.8 to 8.0 acres, but the probability of a blowout would remain low.

Conclusion—First Sale: Impacts to vegetation from activities other than oil exploration and development under Alternative E would be the same as those under Alternative A, except that the effects of archaeological excavation might increase from 1 to 6 acres. The impacts of oil exploration and development would be of the same types as for Alternative B, but greater in areal extent. The maximum acreage affected by 3-D seismic surveys would increase from 0 to 92,000 acres to 92,000 to 460,000 acres. The combined effect of development activities would cause the destruction of vegetation on 140 to 780 acres rather than 0 to 180 acres and the alteration in plant species composition of another 220 to 1,220 acres instead of 0 to 280 acres, for a total of effects over 360 to 2,000 acres rather than 0 to 460 acres. Finally, the occurrence of spills would increase, affecting 1.8 to 8.0 acres under Alternative E instead of 0.5 to 2.6 acres under Alternative B.

Multiple Sales: It is assumed that additional lease sales under Alternative E would result in additional exploration activities and a total of 2 to 10 oilfields being developed. More acreage would be impacted by seismic surveys, but it would be over a longer period of time. It is expected that recovery from at least 90 percent of the impacts from the earliest surveys would be complete before additional seismic operations would commence as a result of multiple sales. The total number of exploratory wells is assumed to increase from 5 to 15 to 15 to 60, and delineation wells from 6 to 23 to 12 to 48, for a total of 27 to 108 wells drilled from ice pads. Vegetation destruction from well collars would increase to affect 0.2 to 0.6 acres, and vegetation death around ice-pad perimeters would increase to 0.7 to 2.7 acres. Tundra would recover from the latter in 1 to a few years.

With the assumption of 2 to 10 oilfields developed, the vegetation that might be destroyed by burial under gravel fill would increase to 200 to 1,000 acres. The area of vegetation around oil field gravel pads that would undergo change from dust or moisture regime impacts would be 400 to 2,000 acres. The impacts of developing material sites would increase correspondingly to the number of oil fields. This would mean the destruction of vegetation on 80 to 400 acres and effects of moisture regime changes on 40 to 200 acres. It is assumed that the number of pump stations required would remain 0 to 2, resulting in the burial of 0 to 80 acres and dust or moisture regime changes on an additional 0 to 120 acres. The number of pipeline miles would increase somewhat under multiple sales, with a total of 120 to 345 mi resulting in the destruction or alteration of a total of 3.5 to 10 acres. The incidence of oil spills would also increase, affecting 3.7 to 16.0 acres of vegetation, but the probability of a blowout would remain low.

Conclusion—Multiple Sales: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time. Exploration activities would also result in 0.2 to 0.6 acres of permanent vegetation destruction around well collars and alteration of 0.7 to 2.7 acres around ice pads. The activities of oilfield development that would impact vegetation include construction of gravel pads, roads, and airstrips for each oilfield; potential construction of up to two pump stations within the planning area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on 280 to 1,480 acres and the alteration in plant species composition of another 440 to 2,320 acres, for a total of effects over 720 to 3,800 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills would affect 3.7 to 16.0 acres of vegetation within the planning area. Recovery from spills would take a few years to 2 decades.

Effectiveness of Stipulations: The effectiveness of stipulations would remain the same as under Alternative B, i.e., there are no stipulations beyond existing management practices that would reduce the above impacts to vegetation.

7. Fish Resources:

a. Activities Other Than Oil and Gas Exploration and Development: Actions associated with Alternative E that may affect fish include the establishment of large work camps at pre-existing airstrips; small scientific excavations for archaeological, paleontological, geologic, and soils-related information; the sport harvest of fish by workers; and actions associated with fuel spills at fuel storage sites. The establishment of work camps, scientific excavations, and the sport harvest of fish are not expected to have a measurable effect on arctic fish populations. Fuel spills at fuel-storage sites may adversely effect arctic fish.

b. Oil and Gas Exploration and Development Activities: Alternative E also involves several management actions associated with oil and gas development. These include seismic surveys; the construction of gravel drill pads, roads, airstrips, and pipelines; and oil spills (drill pad, pipeline, and supply barge). The individual effects of these actions and the chemical agents associated with them have been discussed in previous Beaufort Sea EIS's (e.g., USDOI, MMS, 1996a), which are herein incorporated by reference. The remainder of this analysis focuses on differences in the amount of exposure arctic fish are likely to have to each of these actions in Alternative C as compared to Alternative B. More of the planning area is exposed to oil and gas development in Alternative E (100%) than in Alternative B (44%). This additional area supports a greater number and diversity of fish than the fish-bearing waters of Alternative B. These differences increase the probable number of oil- and gas- related activities, the probability of their affecting arctic fish populations (roughly 5-6 times higher), and the probable overall effect of Alternative E on fish over that of Alternative B.

(1) Effects of Disturbance:

(a) Effects from Seismic Surveys: Arctic fish are likely to be adversely affected by seismic surveys located above overwintering areas. Likely effects would include avoidance behavior and short-term added stress but also could result in the death of some of the more sensitive lifestages (e.g., juveniles). However, the effect on most overwintering fish is expected to consist of only short-term, sublethal effects. While Alternative E is likely to involve more seismic surveys than Alternative A and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Hence, seismic surveys associated with Alternative E are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations). While Alternative E is likely to involve more fuel spills than Alternative A, the amount of fuel entering fish habitat is not expected to increase significantly. Hence, fuel spills associated with Alternative E are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations).

(b) Effects from Construction: Construction-related activities that may affect arctic fish include the construction of drill pads, roads, airstrips, pipelines; and possibly gravel extraction. The individual effects of these activities for Alternative E are expected to be the same as discussed for Alternative B and are summarized below. However, the likelihood of these construction-related activities occurring and affecting fish habitat is roughly five to six times greater in Alternative E than in Alternative B. Depending on the specific level and location of implementation, this could result in a corresponding increase in the overall effect of these activities in Alternative E over that of Alternative B.

Construction during exploration would involve freshwater withdrawals for the construction of ice drill pads, roads, and airstrips. Ice roads or airstrips constructed through overwintering areas <10 ft deep would freeze to the bottom and form a barrier to water circulation, resulting in reduced levels of dissolved oxygen. This could have lethal effects on the fish affected by the barrier. The construction of ice roads and airstrips in nonoverwintering areas is expected to have no measurable effect on arctic fish. Freshwater withdrawals may adversely affect fish, if the water is taken from areas where they are overwintering. Under-ice withdrawals from areas having water and dissolved-oxygen levels barely to moderately sufficient to support to overwintering fish would be likely to kill many of the fish overwintering there. The recovery of affected fish populations would be expected in 5 to 10 years. However, withdrawals from freshwater sources that do not support resident fish populations, or from areas having sufficient under-ice reserves of water and dissolved oxygen, are not likely to adversely affect overwintering fish.

Construction during production would involve the construction of gravel drill pads, roads, airstrips; and a coastal docking facility. The effects of gravel construction and gravel extraction activities in high density areas are expected to be spawning failure and mortality for many of the fish affected (an estimated 10-year recovery). No measurable effects on arctic fish populations are expected in low-density areas. The effects of pipeline trenching through overwintering or spawning habitat are likely to be spawning failure and or mortality of many fish, and a 5 to 10-year recovery period. Trenching that avoids these habitats is not expected to adversely affect fish. The difference in the estimated number of pipeline miles (up to 75 mi for Alternative B and up to 205 mi for Alternative E) is not expected to make a measurable difference in effects on arctic fish in Alternative E. Alternative E also involves the construction of a coastal docking facility, which is needed to offload supply barges into the planning area. The effect of a docking facility on arctic fish would depend on its location and size. Construction of a large facility in offshore waters, requiring a long access road, could adversely affect the movement of some coastal marine and migratory fish (depending on construction characteristics). However, the construction of a relatively small facility in nearshore or shoreline waters, is not likely to affect the movement of marine and migratory fish, since they tend to inhabit waters further offshore. Because supply barges are shallow draft vessels, the docking facility for Alternative E is expected to be constructed in shallow nearshore waters. Additionally, the size of the facility for Alternative E is expected to be relatively small (up to several hundred feet). Hence, the construction of a coastal docking facility associated with Alternative E is not expected to have a measurable effect on arctic fish.

(2) Effects of Spills: The individual effects of oil on fish for Alternative E are the same as discussed for Alternatives A and B. As discussed therein, lethal effects on fish due to a petroleum-related spill are seldom observed outside the laboratory environment. More likely sublethal effects include changes in growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources; and consumption of contaminated prey. The specific effect of oil on fish generally depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). The oil-spill assessment estimates that the amount of oil spilled onshore during the life of the field would be 876 bbl for Alternative E and 280 bbl for Alternative B. For Alternative E it is also assumed that a fuel oil spill, associated with the barging of supplies, would occur in the marine environment. However, neither these differences nor the fact that oil- and gas-related activities are estimated to be five to six times more likely to affect fish in Alternative E are expected to alter the overall effect of oil spills on arctic fish. Hence, oil spills associated with Alternative E are expected to have the same overall effect on arctic fish as discussed for Alternative B. Oil spills are expected to lethally or sublethally affect a small number of the arctic fish in the planning area over the production life of the field.

Conclusion—First Sale: The effect of fuel spills on arctic fish populations in Alternative E are expected to be similar to Alternative A. The individual effects of seismic surveys, construction related activities, and oil spills are expected to be similar to that of Alternative B. However, the likelihood of their occurrence is estimated to be roughly five to six times higher for Alternative E than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of these activities on arctic fish populations in Alternative E over that of Alternative B

Multiple Sales: The actions most likely to affect arctic fish for the first lease sale have been discussed herein and include seismic surveys, construction related activities, fuel spills, and oil spills. While additional northeastern NPR-A lease sales would involve more seismic surveys than the first sale, and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Seismic surveys associated with multiple sales in Alternative C are expected to have the same overall effect on fish as discussed for the first sale (i.e., no measurable effect on arctic fish populations). For additional northeastern NPR-A lease sales that may occur in the future, the number of production pads and pipeline miles have been estimated (Table IV.A.1.b-7). That table estimates that there would be about twice the number of gravel pads as the first sale (Table IV.A.1.b-5). On the basis of this estimate, gravel pads for multiple sales are likely to have about twice the effect on arctic fish as the first sale. Because there is little difference in the estimated number of pipeline miles for multiple sales (up to 280) and the first sale (up to 205), they are expected to have a similar effect as discussed for the first sale. It is estimated that up to 1752 bbl of crude oil would be spilled for multiple sales (or about 2 times that of the first sale (estimated at up to 876 bbl). On the basis of this estimate, crude oil spills for multiple sales are expected to have about twice the effect on acrtic fish as the first sale. However, if there were not enough time between sales to allow for full recovery, or if the level of activity of the selected alternatives were significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations is likely to be greater than estimated herein for multiple sales.

Conclusion—Multiple Sales: Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish as the first sale. Gravel pads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.

Effectiveness of Stipulations: The stipulations having the most beneficial effect on arctic fish are the same as those discussed for Alternative B. However, due to the increased level of potential oil and gas activity associated with Alternative E over that of Alternative B, the absence of these stipulations may increase adverse effects on arctic fish populations.

8. Birds: This section discusses potentially adverse effects of ground- impacting management actions on nonendangered birds within the planning area under Alternative E. Such actions, including oil and gas exploration and development, potentially may result in disturbance factors, habitat alteration or loss, and fuel or oil spills. Effects on birds exposed to such factors would be similar in type but potentially of greater magnitude than those discussed under Alternative B because of the expanded lease area.

a. Activities Other than Oil and Gas Exploration and Development: Management actions other than oil and gas exploration and development under Alternative E, and their potential effects, differ from Alternative A as discussed for Alternative B.

b. Oil and Gas Exploration and Development Activities: Oil and gas leasing would be allowed throughout the planning area (Fig. II.C.1-5; Table IV.A-1) including the Goose Molting Habitat LUEA. The additional acreage leased could result in potential exposure of additional waterbird concentration areas to disturbance. Exploration and development activity under Alternative E will be substantially greater than under Alternative B, with 10 to 28 additional exploratory and delineation wells drilled, 2 to 7 additional production pads, and 80 to 130 additional miles of pipeline. Additional drilling would prolong the period during which disturbance and habitat unavailability would occur by 3 to 5 winter seasons. Additional production pads would displace nesting birds from 60 to 110 acres each for the duration of production, and additional pipeline would result in a slight increase in disturbance from monitoring flights.

Depending on location and season, oil and gas activities in the Goose Molting Habitat LUEA could cause substantial increases in disturbance of geese from routine aircraft operations, and presence of facilities and associated vehicle and foot traffic, in comparison to other alternatives under which this area is not available for lease. Potentially hundreds to thousands of molting geese could be affected to some extent, although a large proportion of disturbing incidents are expected to result in effects from which individuals would recover within hours to 1 day. For example, <1 percent of waterfowl exposed to vehicles at the Lisburne Development Area at Prudhoe Bay caused birds to react negatively, but 85 percent of pedestrians caused reactions (Murphy and Anderson, 1993). However, it is expected that any development that occurs in the planning area will not assume the proportions of the Prudhoe Bay oilfield but will involve significantly smaller and integrated gravel structures with much less extensive interconnection. Also, given the large proportion of the Goose Molting Habitat Area LUEA that is interlake surface where structures could be constructed away from the immediate vicinity of lakes heavily used by molting birds (Fig. IV.B.4-2), there exists the potential for relatively low numbers of birds to be disturbed or displaced. Regardless, some birds are expected to be displaced by structure placement, and this would be a long-term result. Studies at Prudhoe Bay, however, suggest that most nesting birds so displaced will nest in suitable adjacent areas and such areas at Prudhoe Bay were sufficiently extensive for the nesting density of several species to increase (Troy and Carpenter, 1990). Although studies of the short-term effects of disturbance on brant have been done (Sec. IV.B.9), comparable studies indicating the long-term effects on molting populations have not. Presumably, as long as potentially adverse factors are uncontrolled to some degree the potential will exist for disturbance of brant, with resultant energy cost and short-term implications for successful migration, and/or displacement from favored lakes with long-term implications for the brant's use of the area. Implementation of all stipulations (see below and Sec. II.C.7), particularly those concerning proximity and timing of activities, structure placement, and buffering of high-use lakes would appear to remove most potential for disturbance or desertion, but long-term effects probably will be determined only through long-term studies. Less is known of most other species.

The possibility of drilling and placement of pipelines in the Goose Molting habitat Area LUEA suggests a potential for greater oil spill effects during the period molting geese are present than elsewhere in the planning area. However, the small estimated average spill volume suggests that effects will be similar to those discussed under Alternative B. The potential effects of a large spill in this area when geese are present are discussed in Section IV.L.

It is assumed for Alternative E that a fuel-oil spill, associated with the barging of supplies, would occur in the marine environment during August or September when ice cover is <50 percent. Such a spill could contact large flocks of brant, oldsquaw, and/or eiders staging in coastal lagoons or waters farther offshore. Effects on birds would be the same as described for Alternative B. Lethal effects are expected to result from moderate to heavy oiling of any birds contacted. Light to moderate exposure could reduce future reproductive success as a result of pathological effects, caused by oil ingested by adults during preening or feeding, interfering with the reproductive process. A dock assumed necessary for offloading supplies transported by barge is not expected to cause adverse effects on birds. However, common eiders may take advantage of such a structure for nesting activities. The overall population effect is expected to be minimal.

Conclusions: Effects of actions other than oil and gas activity under Alternative E are expected to be essentially the same as for Alternative B, except in the Goose Molting Habitat LUEA where increased activity would result in substantially greater effects. Effects of routine oil and gas activities is expected to be substantially greater than discussed for Alternative B as a result of offering this LUEA for lease; oil spill effects are not expected to be significantly greater that under Alternative B. A fuel-oil spill is expected to cause mortality in the marine environment if contact with flocks of staging waterfowl occurs.

Multiple Sales: If multiple sales occur in the area available for leasing under Alternative E, intensive construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Under a multiple-sale scenario, approximately 2 to 3 times the number of exploration and delineation wells may be drilled (27-108 v. 11-38 for the first sale), the number of fields developed could double (2-10 v. 1-5), and production pads are expected to approximately double (4-16 v. 2-9). Pipeline mileage is expected to increase from 80 to 205 mi to 95 to 280 mi. Surface, air, and foot traffic could increase substantially in some areas if oilfield facilities associated with multiple sales are grouped in high-resource-interest areas; if these coincide with high-bird-concentration areas greater numbers of individuals are expected to be displaced and more species involved than with a single sale. Such increases may cause substantial changes in planning area population levels. Effects from disturbance and habitat alteration or loss on birds is expected to increase throughout most of the planning area with multiple sales under Alternative E.

The estimated number of onshore oil spills >1 bbl is expected to increase from 13 to 55 under the first sale to 25 to 109 with multiple sales (Tables IV.A.2-3a, IV A2-3b); this doubling of spills is expected to cause substantially greater loss of individuals and increased number of species involved. An increase from 116 to 510 small refined-oil spills under the first sale (average size of 29 gal) to 232 to 1,021 with multiple sales is expected over the production life of the planning area (Tables, IV A 2-6a and IV A 2-6b). Although generally these small chronic spills are contained and cleaned up on pads and roads, a doubling of their occurrence is expected to have a similar increased effect on birds and their habitats as with the first sale. Habitat contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. Any habitat contamination that is not effectively cleaned up is likely to persist for several years but is not expected to affect populations significantly. Recovery of cumulative lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods data available.

Conclusion—Multiple Sales: Displacement of birds from disturbance and habitat alteration or loss is expected to increase substantially throughout most of the planning area under Alternative E, but not significantly affect planning area populations. Increases in oil and refined oil spills are expected to result in the loss of substantial numbers of birds, but these losses and recovery of cumulative lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods data available. Overall effect is expected to increase substantially from that discussed for the first sale.

Effectiveness of Stipulations: Effectiveness of stipulations under Alternative E is expected to be essentially the same as described under Alternatives A, B, C and D, except that several specific stipulations (e.g., 17, 20-l, 22, 25, 30, 32, 33, 34, 50-d, 54, 55, 77) would mitigate many of the disturbance and habitat degradation effects that could occur in the Goose Molting Habitat Area LUEA described above, including: (21) seasonally restricting drilling operations; (22, 32) avoidance of critical lakeshore margin goose-feeding habitat during oil and gas activities; (33) incorporation of visual screening features for facilities near goose-molting lakes; (78) public access to goose molting through oilfields prohibited (loons, waterfowl, shorebirds, passerines); (60) sites rendered unusable for enhanced access to the Goose Molting LUEA when abandoned; (29, 30) minimizing pads and connecting roads, consolidation/integration of oil and gas facilities.

9. Mammals:

a. Terrestrial Mammals:

Among the terrestrial mammal populations that could be affected under

Alternative E are caribou of the of the Teshekpuk Lake Herd (TLH) and the Central Arctic Herd (CAH). Moose, muskoxen, grizzly bears, wolves, wolverines, and arctic foxes may be locally affected by planning area activities.

(1) Activities Other than Oil and Gas Exploration and Development: The level of activities such as resource inventories, aerial surveys, and research camps is expected to increase somewhat under Alternative E compared to Alternative A, but the level of effect is expected to be about the same.

(2) Oil and Gas Exploration and Development Activities: Under Alternative E, one to five oil fields are assumed to be discovered and developed. Primary effects on terrestrial mammals would come from motor-vehicle traffic within the oilfield(s). Other effects could come from foot traffic near facilities and camps; from aircraft traffic; from small, chronic crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and from habitat alteration associated with gravel mining and construction. (Please see Alternative B, Sec. IV.C.9.a, for a discussion of general effects of disturbance and spills.) In the following discussion, for purposes of analysis, the planning area is divided into thirds—northern (including Teshekpuk Lake and the Beaufort coast), middle (the area generally west and southwest of Nuiqsut), and southern. The entire planning area is open for leasing and development under Alternative E (Fig. II. C.1-5).

(a) Effects of Disturbance: If a field or fields are developed in the northern planning area, production pads, pipelines, within-field roads, and other facilities (housing, airfield, processing plant) could be located within the TLH calving area to the north, south, and east of Teshekpuk Lake (Fig. III.B.5.a-1). Calving is expected to be displaced with 1.86 to 2.48 mi (3-4 km) of within-field roads. Movements of cows and calves across these roads is expected to be greatly reduced, and cow caribou may avoid crossing the roads during the calving season. If roads transect the caribou-calving movements between the east shoreline of Teshekpuk Lake and Kogru Inlet (Fig. III.B.5.a-1), cow caribou may avoid or reduce calving in habitats north and east of the lake. The caribou movement corridor and calving habitat located between the eastern shore of Teshekpuk Lake and Kogru Inlet was identified as crucial habitat for the TLH (Yokel et al., 1997; Fig. III.B.5.a-1). If east-west roads are located within the movement corridor, then a shift in the relative calving distribution of the TLH from the north side of the lake to the south is expected to occur (Fig. III. B.5.a-1). Movements of the TLH to the coast of the planning area (Fig. III.B.5.a-1) during the insect-relief season (late June-August 15) also are expected to be adversely affected by pipelines and roads with vehicle traffic located east of Teshekpuk Lake.

If a field is developed in the middle planning area, there would be no effect on TLH calving or the TLH calving area. Some TLH migration movements may be adversely affected by air and surface traffic along pipelines and roads within the oilfield. If a field is developed in the southern planning area, some members of the CAH, CAH, and TLH would encounter the field during their fall migration route and within a portion of their winter range. However, neither the pipeline to the TAPS nor facilities within the oilfield would be expected to significantly affect the movement of caribou or alter their distribution or abundance.

A pipeline from the oilfield(s) would connect to the TAPS through facilities at the Alpine and Kuparuk River fields. The pipeline would be constructed during winter using ice roads, so that no permanent road would be associated with the pipeline. During construction, air traffic would include several flights per day, which could temporarily disturb some of the caribou of the TLH and CAH and other terrestrial mammals within about 1.2 mi (2 km) of the pipeline. Disturbance effects on caribou and other terrestrial mammals are expected to be short term, interference with mammal movements would be temporary (probably a few minutes to less than a few days), and the mammals eventually would cross the pipeline area. Additionally, disturbance reactions would diminish after construction, and flights would decrease to about one or two per day at most. The abundance and overall distribution of terrestrial mammals are not expected to be affected by pipeline construction or operation.

(b) Effects of Spills: For general information on the effects of oil spills on terrestrial mammals, please see the discussion under Alternative B (Sec. IV.C.9.a). Chronic crude-oil and fuel spills from onshore activities and possible marine transportation probably would result in the loss of small numbers of terrestrial mammals. Under Alternative E, an estimated 13 to 55 (>1 bbl) crude-oil spills (averaging 4 bbl) and 116 to 510 small refined-oil spills (averaging 29 gal) are assumed to occur onshore over the production life of the planning area (Tables IV.A.2-2 and 2-6). These small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B.

If barging of refined fuel oil occurs in association with Alternative E during the open-water season, caribou of the TLH and CAH that frequent coastal habitats from Prudhoe Bay to Camp Lonely-Pitt Point could be directly exposed to and contaminated by a potential fuel spill along beaches and in shallow waters during periods of insect-escape activities. However, even in a severe situation, a comparatively small number of animals is likely to be directly exposed to the oil spill and die as a result of toxic-hydrocarbon inhalation and absorption. This loss probably would be small for any of the caribou herds, with these losses replaced within less than one generation (about 1 year).

Conclusion—First Sale: Activities other than oil and gas are expected to increase somewhat under Alternative E compared to Alternative A, but the increase is not expected to affect terrestrial-mammal populations. For oil and gas activities, effects of Alternative E are expected to be significantly greater than those of Alternative B, with more helicopter disturbance of caribou and other terrestrial mammals. Increased habitat alteration would include the development of one to five oil fields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic. Near the oil fields, surface, air, and foot traffic are expected to increase significantly and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. If a field is developed in TLH caribou-calving areas, some calving is expected to be displaced within 1.86 to 2.48 mi (3- 4 km) of roads and other production facilities over the life of the project. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.

Multiple Sales: If several lease sales occur under Alternative E, considerably more exploration activity is expected to occur in the Teshepuk Lake calving habitat of the TLH caribou with the number of wells drilled increasing from 5 to 15 under the first sale to 15 to 60 under multiple sales. The amount of development also is expected to increase, with the number of oilfields increasing from 1 to 5 under the first sale to 2 to 10 under multiple sales, with the number of production pads increasing from 2 to 9 under one sale to 4 to 16 under multiple sales, and pipeline miles increasing from 80 to 205 under the first sale to 95 to 280 under multiple sales. An increase the potential displacement of calving TLH caribou along roads between the increase number of production pads and other facilities. An increase in the number or miles of roads and other facilities with development under multiple sales is also expected to increase the impedance of TLH caribou movements to insect-relief areas along the coast, north of Teshekpuk Lake. The displacement of calving caribou represents a functional loss of habitat within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH.

Under Alternative E multiple sales, the number of small crude-oil spills is expected to increase from an estimated 13 to 55 (>1 bbl) under the first sale to 25 to 109 (averaging 4 bbl) under multiple sales and from 116 to 510 small refined-oil spills under the first sale to 232 to 1,021 under multiple sales (averaging 29 gal) over the production life of the planning area (Tables IV.A.2-3a, IV.A2-3b, IV.A.2-6a, and IV.A.2-6b). These small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B but with loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations.

Conclusion—Multiple Sales: The effect of multiple sales under Alternative E is expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.

Effectiveness of Stipulations: Stipulations described in Section II.C.7 in regard to solid- and liquid-waste disposal, fuel handling, and spill cleanup are expected to reduce the potential effects of spills and human refuse on terrestrial mammals. Stipulations on overland moves and seismic work are expected to minimize alteration of terrestrial mammal habitats. The stipulation on aircraft to maintain a 1,000-ft AGL (except for takeoffs and landings) over caribou winter ranges from October through May 15, and to maintain a 2,000-ft AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, is expected to minimize disturbance of caribou.

Stipulations on oil and gas exploration and development, including facility design and construction, and restrictions on use of oilfield roads and airstrips for public use are expected to minimize alteration of terrestrial mammal habitat and interference with caribou movements. Stipulations that restrict permanent surface occupancy of oil and gas facilities within 2 mi of the coast and east of Teshekpuk Lake to Kogru Inlet are expected to reduce disturbance and interference with caribou movements, in particular the movements of caribou to and from the coast for insect relief and the movements of TLH cow caribou to calving habitats north of the lake. Stipulations requiring elevated pipelines and roads to be separated at least 500 ft and to place pipelines on the appropriate side of the road (depending on general movements of caribou in the area) significantly could reduced interference with caribou movements. A stipulation prohibiting permanent surface occupancy other than buried pipelines within the two narrow land corridors identified as crucial caribou movement corridors between Teshekpuk Lake and the Beaufort Sea further would reduce or avoid interference with THL caribou movements (Fig. III.B.5.a-1).

Residual Impacts: Implementation of all the above stipulations would reduce but not eliminate all effects on TLH caribou. Some level of displacement of calving still is expected to occur within 1.86 to 2.48 mi (3-4 km) of oilfield roads, and some caribou movements during insect harassments would be temporarily disrupted when caribou encounter road and foot traffic in association with production facilities. These disruptions would have some adverse energetic effects on individual caribou.

b. Marine Mammals: Under Alternative E, the northern coast of the planning area, which extends from the Colville River delta west to Smith Bay, would be open to leasing. Six species of nonendangered marine mammals—ringed, spotted, and bearded seals, walruses, polar bears, and belukha whales—commonly occur year-round or seasonally in coastal habitats adjacent to the planning area. Under Alternative E, some individual members of these species may be exposed to effects from oil and gas exploration and development activities as well as from other activities.

(1) Activities Other than Oil and Gas Exploration and Development: Non-oil and gas exploration and development activities along the coast that may affect marine mammals include aerial surveys (including surveys of wildlife); ground activities such as resource inventories, paleontological excavations, research and recreation camps; and overland moves. Effects under Alternative E would be similar to those for Alternative A--local and short term, with no significant adverse effects to the populations as a whole.

(2) Oil and Gas Exploration and Development Activities: Oil and gas exploration and development activities along the coast that may affect marine mammals are noise and disturbance from air and surface traffic, geophysical seismic activities, and potential oil pollution of marine waters. (Some of the crude- and fuel-oil spills associated with Alternative E that are assumed to occur in the Teshekpuk Lake area may reach the marine environment and potentially affect marine mammals.)

(a) Effects of Noise and Disturbance: Noise associated with oil and gas activities is a main source of disturbance to seals, polar bears, and belukha whales. For a discussion of the nature of airborne and underwater noise effects on pinnipeds, polar bears, and belukha whales, see the Sale 124 FEIS (USDOI, MMS, 1990). A discussion of noise and disturbance effects specific to the planning area follows.

The primary source of noise and disturbance would come from air traffic along the coast of the planning area, specifically from helicopters associated with the assumed oil exploration and production activities. Aircraft traffic (several helicopter round trips/year during exploration and development) centered out of Deadhorse-Prudhoe Bay and Camp Lonely, traveling to and from NPR-A exploration and production facilities, is assumed to be a source of disturbance to ringed or spotted seals hauled out on ice or beaches, respectively, and polar bears using coastal habitats.

During the summer, some of the air traffic to and from exploration and production facilities could disturb hauled-out seals, causing them to charge in panic into the water. This disturbance could result in injury or death to young seal pups. The number of seals affected would depend on the number of disturbance incidents.

If exploratory drilling occurs in winter (December to mid April) near the coast, polar bears could be attracted to the oil field camps by food odors and curiosity. Some polar bears could be unavoidably killed to protect oil workers. However, the number of bears lost as a result of such encounters is expected to be very low.

(b) Effects of Geophysical Seismic Activities: Effects will be similar to those under Alternative A, i.e., short-term effects on a small number of polar bears that den along the coast of the planning area could occur.

(c) Effects of Oil Pollution: For a discussion of the effects of oil on marine mammals that commonly occur in offshore habitats adjacent to the planning area, see USDOI, MMS (1997). For detailed discussions of the various possible direct and indirect effects of oil on marine mammals, see OCS Reports MMS 85-0031 and MMS 92-0012 (Hansen, 1985; 1992).

1) Effects from a Possible Spill in Marine Waters: A possible fuel spill that might occur nearshore within the marine environment could affect some ringed, bearded, and spotted seals. Assuming a fuel-oil spill occurred during the summer open-water period, a small number of ringed, spotted, and bearded seals might be contaminated. Small aggregations of ringed seals do occur in open water. Such an event could result in the contamination and possible loss of some seals out of populations of a few thousand to several thousand seals.

Fuel-oil contamination of walruses probably would not result in direct mortality of healthy individuals. However, contamination seriously could stress diseased or injured animals and stress young calves, causing some deaths. Perhaps a small number of calves and some adults could die from fuel-oil contamination, but such a loss is expected to be replaced within 1 year by natural recruitment in the population (out of a population >200,000 walruses). Little or no significant contamination of benthic food organisms and bottom-feeding habitats of walruses and bearded seals is expected, because the small fraction of the fuel spill expected to reach this area (such as 1-5%) is expected to be widely dispersed in the water column and to be weathered and degraded by bacteria (USDOI, MMS, 1997, Sec. IV.A.3, Spilled Oil Fate and Behavior in Marine Waters). The amount of benthic prey killed or contaminated by the fuel spill is likely to be very small and represent an insignificant proportion of the prey and benthic habitat available.

Polar bears would be most vulnerable to oil-spill contamination from Cape Halkett to Point Barrow (Fig. III.B.5b). However, the number of bears likely to be contaminated, or to be indirectly affected by a local reduction in seals, probably would be small, considering the approximate density of one bear every 141 to 269 km^2 (54-103 mi^2) (Amstrup Stirling, and Lentifer, 1986). Even in a severe situation where a concentration of perhaps 10 bears (such as at a whale carcass site) was contaminated by the fuel spill and all the bears died, this one-time loss is not expected to significantly affect the polar bear population of 1,300 to 2,500 animals. Annual recruitment (current growth rate of 2.4%) probably would replace lost bears within 1 year (given the potential biological removal rate or available yield of 48 bears/year and assuming equal sex ratio of removed bears and a subsistence harvest of 20-30 bears/year (USDOI, FWS, 1995). Assuming a Beaufort Sea polar bear population of 2,000 and a sex ratio of 2:1 male to female, the sustainable yearly harvest would be about 76 bears, which is considerably more than recent annual subsistence harvest of bears from this population under the North Slope Borough Inuvailuit Game Committee Management Agreement on Polar Bears (Nageak, Brower, and Schliebe, 1991). Thus, the additional loss of 10 bears from a possible fuel spill is not expected to significantly affect the population.

Belukhas of the western Beaufort population may have some contact with a spill (hydrocarbons in the water column or on the surface) that would temporarily contaminate the marine environment; however, few, if any, belukha whales are likely to be seriously affected, even in a severe situation, with no significant effect on the population.

2) Effects from Onshore Spills: A total of 13 to 55 crude-oil spills (>1 bbl) with an assumed size of 4 bbl and a total of 116 to 510 small fuel-oil spills with an average size of 29 gallons are estimated to occur onshore under Alternative E (Tables IV.A.2-2 and IV.A.2-6). These small onshore spills are expected to have little effect on seals, walruses, and polar bears. If some of these spills occur in or contaminate streams in the Teshekpuk Lake area, that drain into marine waters, small numbers of seals, polar bears, and other marine mammals might be exposed to contamination in nearshore habitats and suffer lethal or sublethal effects. A small number of breeding ringed seals and their pups could be contaminated by any of these spills that reach the marine environment during early winter, resulting perhaps in the death of some pups (perhaps 10 to 30 animals, because of the small size of these spills and the sparse distribution of pupping lairs). Even smaller numbers of polar bears, walruses, and belukha whales are expected to be exposed to and affected by these small spills.

Conclusion—First Sale: For marine mammals, the effects of non-oil and gas activities under Alternative E are expected to be similar to those under Alternative A—local and short term, with no significant adverse effects to the populations as a whole. The effects of oil and gas activites for Alternative E are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance and oil pollution effects is expected to occur along the coast.

Multiple Sales: If several lease sales occur under Alternative E, considerably more exploration activity is expected to occur along the coast of the Teshekpuk Lake area with the number of wells drilled increasing from 5 to 15 under the first sale to 15 to 60 under multiple sales. The amount of development also is expected to increase, with the number of oilfields increasing from 1 to 5 under the first sale to 2 to 10 under multiple sales, with the number of production pads increasing from 2 to 9 under the first sale to 4 to 16 under multiple sales, and pipeline miles increasing from 80 to 205 under the first sale to 95 to 280 under multiple sales. This increased activity could result in an increase in aircraft disturbance of seals hauled out on the ice along the coast north of Teshekpuk Lake, and an increase in onshore surface traffic activity (seismic exploration, overland moves, construction activities along the coast) could result in more disturbance of polar bears denning and foraging along the coast. However, these effects are expected to be local and short term, with no significant adverse effects to the polar bear and seal populations as a whole.

Under Alternative E multiple sales, the number of small crude-oil spills is expected to increase from an estimated 13 to 55 (>1 bbl) under the first sale to 25 to 109 (averaging 4 bbl) under multiple sales and from 116 to 510 small refined-oil spills under the first sale to 232 to 1,021 under multiple sales (averaging 29 gal) over the production life of the planning area (Tables IV.A.2-3a, IV.A2-3b, IV.A.2-6a, and IV.A.2-6b). These small onshore spills are expected to have little effect on seals, walruses, and polar bears. If some of these spills occur in or contaminate streams in the Teshekpuk Lake area that drain into marine waters, small numbers of seals, polar bears, and other marine mammals might be exposed to contamination in nearshore habitats and suffer lethal or sublethal effects.

Conclusion—Multiple Sales: Multiple sales under Alternative E are expected to have similar effects to those under Alternative E in the first sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Effectiveness of Stipulations: The effectiveness of stipulations is expected to be the same as under Alternative A. However, Stipulation 26, which generally would require that facilities be 2 mi from the coast, may offer some protection from spills reaching the marine environment.

10. Endangered and Threatened Species:

a. Activities Other Than Oil and Gas Exploration and Development: Such activities associated with the management plan still would occur under this alternative. Ground-impacting management actions within the planning area that may affect bowhead whales and spectacled and Steller's eiders under Alternative E include aerial surveys (including that of wildlife) and ground activities, such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall. A description of these activities and potential effects on these species are discussed in Alternative A and summarized herein. The potential effects from these activities are expected essentially to be the same as described for Alternative A. A detailed discussion of all management actions is found in Section II.

Bowhead whales are not likely to be affected by any activities associated with the management plan. Some eiders may be affected by activities associated with aircraft traffic and hazardous- and solid-material removal and remediation. Under this alternative, there would be an increase in the number of aircraft flights for point-to-point flights, aerial wildlife surveys, and other aerial surveys. Point-to-point flights increase from occasional to daily flights. Aerial wildlife surveys increase from 14 to 21 days during June and July, and other aerial surveys increase from occasional flights to several 2- to 3-week periods. Summertime aircraft flights over sensitive areas for eiders may affect nesting females and their broods. Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake (spectacled eider LUEA, Fig.II.B.3) may be overflown by aircraft (both helicopters and fixed-wing) on a regular basis during the summer months and may experience temporary, nonlethal effects. Due to the relatively low density of eiders in the area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

b. Oil and Gas Exploration and Development Activities: Under Alternative E, oil and gas leasing would occur throughout the planning area. The analysis contained in this section is based on a development scenario presented in Section IV.A.1.b of this EIS. The reader is referred to these sections for a discussion of resource-recovery rates and quantities, timing of infrastructure development, platform emplacement, wells drilled, and resource-production timeframes and other information relevant to the development of the resources of the proposed action. The BLM proposes to conduct multiple oil and gas lease sales within the planning area. Multiple sales are discussed later in this section. Under Alternative E, oil resources for the initial sale are expected to be in the 250- to 1,100-MMbbl range from one to five fields, which is considered a reasonable range of resource development and activity level for the portion of the planning area open to leasing (Table IV.A.1.b-4). Information on the number of exploration, delineation, and production wells anticipated to be drilled and pipeline miles can be found in Table IV.A.1.b-5. Differences in effects on the species as a result of noise and disturbance over this range of scenarios are expected to be minor. Differences in effects on the species as a result of an oil spill during the development/production scenario (250-1,100-MMbbl-resource range) also are expected to be minor.

For Alternative E, it is estimated that from 37 to 164 spills <1 bbl would occur, and from 13 to 55 spills >1 bbl would occur over the assumed production life of the planning area (Table IV.A.2-3a). For the purposes of analysis, this EIS assumes an average spill size of 4.0 bbl and that the estimated number of crude-oil spills over the assumed production life of the planning area would range from 50 to 219 spills (Table IV.A.2-2a). Information pertaining to oil spills can be found in Section IV.A.2. It is also assumed for Alternative E that a fuel-oil spill, associated with the barging of supplies, would occur in the marine environment during August or September.

(1) Effects on the Bowhead Whale: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills associated with oil and gas activities or other activities associated with the management plan are expected essentially to be the same under this alternative as under Alternative B. If a discovery is made adjacent to the coast, there is a small possibility that noise from drilling activities during the fall whale migration may affect some whales migrating closer to shore. Affected bowheads may respond to noise from drilling units by slightly changing their migration speed, swimming direction, or some other minor change in behavior, although such effects are unlikely. However, due to sound attenuation from onshore drilling operations and the distance sound would have to travel to reach the whales, it is unlikely that any noise from drilling operations would reach bowhead whales. Although a discovery adjacent to the coast would increase the potential for an oil spill reaching marine waters, no oil spills are expected to occur in the marine environment due to the small size of most spills that are likely to occur in the area. Small onshore spills are unlikely to reach the marine environment. It is very unlikely that oil spills would have any effect on bowhead whales. Assuming a fuel-oil spill occurred in bowhead whale habitat while bowheads were present, some whales could experience one or more of the following: skin contact, baleen fouling, respiratory distress caused by inhalation of hydrocarbon vapors, localized reduction in food resources, consumption of some contaminated prey items, and perhaps a temporary displacement from some feeding areas. The number of whales contacted would depend on the size, timing, and duration of the spill; the density of the whale population in the area of the spill; and the whales' ability or inclination to avoid contact with the spilled fuel-oil.

(2) Effects on the Spectacled and Steller's Eiders: The potential effects on spectacled and Steller's eiders from discharges, seismic surveys, construction activities, and oil spills associated with oil and gas activities are expected essentially to be the same under this alternative as under Alternative B. Assuming a fuel-oil spill occurred in marine waters while eiders were present, some mortality would likely occur as a result of hypothermia. Some eiders could ingest fuel-oil from preening of oiled feathers and be prone to various pathological conditions such as endocrine dysfunction, liver-function impairment, weight loss, etc. The potential effects as a result of noise and disturbance associated with oil and gas activities, such as aircraft traffic, vessel traffic, and perhaps drilling of development and production wells and oil-spill-cleanup activities, are likely to increase, because all of the eider breeding and nesting areas in the planning area are in areas available to oil and gas activities under this alternative. The area north, east, and west of Teshekpuk Lake (includes spectacled eider LUEA) is available for drilling and has a relatively high density of spectacled eiders compared to areas south of Teshekpuk Lake. Although Steller's eiders are present in the planning area, it is not known for certain if they actually breed in the planning area. It is unlikely that the primary Alaskan nesting area for Steller's eiders, located south and southeast of Barrow, would be affected much by these activities; so significant disturbance of nesting or broodrearing eiders is not expected to occur. Eiders exposed to noise and disturbance from oil and gas activities may experience temporary, nonlethal effects, probably lasting less than an hour but, in the case of summer drilling operations, could continue all summer. However, due to the relatively low density of eiders in the area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Therefore, the effects on eiders should be limited, with only a few eiders exposed to oil and gas activities. Disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

Conclusion—First Sale: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills are expected essentially to be the same under this alternative as under Alternative B. Some whales exposed to a fuel-oil spill could experience one or more of the following: skin contact, baleen fouling, respiratory distress caused by inhalation of hydrocarbon vapors, localized reduction in food resources, consumption of some contaminated prey items, and perhaps a temporary displacement from some feeding areas. The number of whales contacted would depend on the size, timing, and duration of the spill; the density of the whale population in the area of the spill; and the whales' ability or inclination to avoid contact with the spilled fuel-oil. Some eiders exposed to a fuel-oil spill may suffer mortality as a result of hypothermia while others may ingest fuel-oil from preening of oiled feathers and be prone to various pathological conditions such as endocrine dysfunction, liver function impairment, and weight loss. The potential effects on spectacled and Steller's eiders from discharges, some noise and disturbance, and oil spills associated with oil and gas activities are expected essentially to be the same under this alternative as under Alternative B. Some spectacled and Steller's eiders in the planning area may be exposed to oil and gas activities and may experience temporary, nonlethal effects as a result of increased aircraft traffic, vessel traffic, and perhaps drilling of development and production wells and oil-spill-cleanup activities. There also may be an increase in potential effects on eiders from activities other than oil and gas associated with the management plan due to an increase in summertime aircraft flights over sensitive areas that may affect nesting females and their broods. Under this alternative, there would be an increase in the number of aircraft flights for aerial wildlife surveys and other aerial surveys. Aerial wildlife surveys in June and July increase from 14 days to 21 days. Spectacled and Steller's eiders breeding, nesting, or rearing young in coastal habitats may be overflown by support aircraft and may experience temporary, nonlethal effects. In the central portion of the planning area, Steller's eiders occasionally may be overflown by support aircraft and may experience temporary, nonlethal effects. It is unlikely that the primary Alaskan nesting area, located south and southeast of Barrow, would be affected much by these activities; so significant disturbance of nesting or broodrearing eiders is not expected to occur. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative E increases from a range of 250 to 1,100 MMbbl in 1 to 5 oilfields (Table IV.A.1.b-4) to a range of 500 to 2,200 MMbbl in 2 to 10 oilfields (Table IV.A.1.b-6). The number of exploration wells increase from a maximum of 15 to 60, delineation wells increase from a maximum of 23 to 48, and production wells increase from a maximum of 330 on 9 pads to 660 on 16 pads. Pipeline miles increase from 205 to 280 mi (Tables IV.A.1.b-5 and 7). Multiple sales would occur over a longer period of time and, depending on frequency of sales and results from exploratory drilling operations, possibly increase the timeframe for oil and gas activities in the planning area by a couple of decades.

For Alternative E, it is estimated that the number of spills <1 bbl would increase from a range of 37 to 164 spills to a range of 75 to 329 spills, and the number of spills >1 bbl would increase from a range of 13 to 55 spills to a range of 25 to 109 spills over the assumed production life of the planning area (Tables IV.A.2-3a and IV.A.2-3b). The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 50 to 219 spills to a range of 100 to 438 spills (Tables IV.A.2-2a and IV.A.2-2b). Information pertaining to oil spills can be found in Section IV.A.2.

Conclusion—Multiple Sales: The effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the single sale.

Effectiveness of Stipulations: The effectiveness of stipulations for noise and disturbance from oil and gas activities is the same as Alternative B; and from activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, would be the same as Alternative A.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: Alternative E would generate recreation-field employment by 22, 1-week long float-trip parties per year (Table II.H.3.b), equal to one person for 6 months each year.

b. Oil and Gas Exploration and Development Activities: Increased revenues and employment are the most significant economic effects that would be generated by Alternative E. Increased property-tax revenues and new employment would be created with the construction, operation, and servicing of facilities associated with oil and gas activities. These facilities are described in Table IV.A.1-1 and are summarized as follows. For exploration, 5 to 15 exploration and 6 to 23 delineation wells would be drilled between 2000 and 2009; for development, 75 to 330 production and service wells would be drilled, 2 to 9 production pads constructed, and 80 to 205 mi of onshore pipeline installed between 2006 and 2017. The number of workers needed to operate the infrastructure is determined by the scale of the infrastructure and not by the amount of oil produced. A wide range of production volume can be handled by a given level of infrastructure. Once the infrastructure is constructed, the number of workers needed to operate it does not depend on the amount of product flowing through it. Effects include employment generated by seismic surveys during exploration. State property-tax revenues are in proportion to the value of onshore facilities. State royalty income and State severance tax are in proportion to production. Peak yearly production is estimated at 21 to 81 MMbbl. (For complete descriptions of resources and associated activity, please see Section IV.A.1.b.)

(1) North Slope Borough Revenues and Expenditures: Exploration, development, and production are projected to generate increases in property taxes above the levels without Alternative E activities starting in 2000 and averaging about 3 to 6 percent each year through the production period, or about $6 to $12 million.

(2) NSB Employment: The gains from Alternative E in direct employment would include jobs in petroleum exploration, development, and production and jobs in related activities (Table IV.F.11-1). Direct employment is anticipated to peak in the range of 2,200 to 4,200 jobs during the development phase, and decline to a level in the range of 700 to 1,400 during production from 2018 to 2028.

Table IV.F.11-1
Summary of Employment Forecasts, Alternative E

	IAP Employment in Enclave			NSB Resident Employment		
	Without IAP Activity	With IAP Activity		Without IAP Activity	*Increase with IAP Activity*	
Year		$18/bbl	$30/bbl		$18/bbl	$30/bbl
1999	0	0	0	1,865	0	0
2000	0	99	118	1,825	2	2
2001	0	179	278	1,794	8	11
2002	0	179	358	1,767	12	20
2003	0	279	543	1,746	15	28
2004	0	59	323	1,730	15	33
2005	0	429	618	1,716	13	30
2006	0	2,241	3,505	1,701	64	85
2007	0	1,376	2,255	1,685	56	74
2008	0	1,262	2,262	1,662	29	50
2009	0	1,094	3,572	1,614	24	74
2010	0	707	1,997	1,565	14	42
2011	0	702	3,652	1,513	18	82
2012	0	731	2,734	1,470	22	73
2013	0	722	2,443	1,431	23	77
2014	0	722	4,195	1,393	23	118
2015	0	722	2,200	1,357	23	70
2016	0	722	2,000	1,350	23	70
2017	0	722	2,000	1,330	23	70
2018	0	722	1,400	1,310	23	60
2019	0	722	1,400	1,290	23	60
2020	0	722	1,400	1,290	23	60
2021	0	722	1,400	1,310	23	60
2022	0	722	1,400	1,330	23	60
2023	0	722	1,400	1,350	23	60
2024	0	722	1,400	1,370	23	60
2025	0	722	1,400	1,390	23	60
2026	0	722	1,400	1,410	23	60
2027	0	722	1,400	1,430	23	60
2028	0	722	1,400	1,450	23	60

Sources: Resident employment 1999–2015, Rural Alaska Model, North Slope Borough, 1996; IAP employment and resident employment 2016–2028, Manpower Model and MMS

Table IV.F.11-2
Summary of NSB Population Forecasts, Alternative E

		Increase in Resident Population				Increase in Resident Population	
Year	Resident Population No IAP Activity	IAP Activity $18/bbl	IAP Activity $30/bbl	Year	Resident Population No IAP Activity	IAP Activity $18/bbl	IAP Activity $30/bbl
1999	6,067	0	0	**2014**	6,582	69	354
2000	6,134	6	6	**2015**	6,423	69	210
2001	6,213	24	33	**2016**	6,300	69	210
2002	6,301	36	60	**2017**	6,200	69	210
2003	6,391	45	84	**2018**	6,100	69	180
2004	6,488	45	99	**2019**	6,000	69	180
2005	6,684	39	90	**2020**	6,000	69	180
2006	6,695	192	255	**2021**	6,100	69	180
2007	6,820	168	222	**2022**	6,200	59	180
2008	6,918	87	150	**2023**	6,300	69	180
2009	7,011	72	222	**2024**	6,400	69	180
2010	7,050	42	126	**2025**	6,500	69	180
2011	7,004	54	246	**2026**	6,600	69	180
2012	6,891	66	219	**2027**	6,700	69	180
2013	6,743	69	231	**2028**	6,800	69	180

Sources: For years 1999–2015, Rural Alaska Model, North Slope Borough, 1996. For 2016–2028, MMS

Total NSB resident employment is anticipated to increase in the range of 64 to 118 jobs in the peak of development and level off to 23 to 60 during production after 2017 (Table IV.F.11-1). The peak increase in resident employment is about 4 to 8 percent greater with Alternative E than without during development, and about 2 to 5 percent greater during production. The increase in employment opportunities partially may offset declines in other job opportunities and delay expected outmigration. Increases in resident population would correspond to increases in employment (Table IV.F.11-2).

No workers would be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

(3) Effects of Subsistence Disruptions on the NSB Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents primarily through the direct loss of subsistence resources. See Section IV.F.13 for effects on subsistence-harvest patterns.

(4) State Revenues: State revenues would increase as a result of the Alternative E. Property-tax revenues to the State will be approximately 25 percent of the revenues to the NSB, or $1.5 to $3 million annually. State royalty income would be in proportion to production, or approximately $9.25 million for each 1 MMbbl of oil produced and flowing through the TAPS, or $2.5 to $10 million annually. State severance tax will be half that amount, or $1.25 to $5 million annually.

(5) Southcentral Employment: Workers in the enclave centered at Prudhoe Bay probably would commute to permanent residences in Southcentral Alaska, Fairbanks, and outside the State. However, for the purpose of this analysis, it is assumed all of the enclave workers (Table IV.F.11-1) commute to Southcentral Alaska and have permanent residences there except during peak construction years.

Population in Southcentral Alaska generated directly and indirectly by enclave workers during production would be in the range of 10,500 to 21,000, or 2.8 to 5.7 percent of the Southcentral population. In the 7-year period of the exploration and development phases, the population directly and indirectly associated with Alternative E would rise to the level sustained during production.

Conclusion—First Sale: Activities other than oil and gas exploration and development for Alternative E would generate recreation-field employment by 22, 1-week long float-trip parties per year (Table II.H.3.b), equal to one person for 6 months each year. For oil and gas exploration and development activities for Alternative E, production in Alternative E is projected to generate increases above the levels of Alternative B as follows: NSB property taxes, 3 to 4 percent ($6 to $9 million); direct oil-industry employment, 700 (5 x this in additional jobs) residing in Southcentral Alaska; NSB- resident employment, 2 to 3 percent; and annual revenues to the State of $1.5 to $2.25 million, $2.5 to $6 million, and $1.25 to $3 million from property tax, royalty income, and severance tax, respectively.

Multiple Sales: The effect of multiple sales for Alternative E is projected to be approximately two times that of the first sale for Alternative E.

Conclusion—Multiple Sales: The effect of multiple sales for Alternative E is projected to be approximately two times that of the first sale for Alternative E.

Effectiveness of Stipulations: There are no mitigating measures that would change potential economic effects.

12. Cultural Resources:

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Cultural resources (the physical remains resulting from the activities of historic or prehistoric humans) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative E, the management-action impacts generally would be the same as under Alternative A, except the intensity of the actions would increase due to potential oil and gas exploration.

(2) Oil and Gas Exploration and Development Activities:

(a) Effects of Disturbance from Exploration: The types of oil and gas exploration activities that would occur under Alternative E would be the same as those that would occur under Alternative B. However, the level or intensity of these exploration activities would increase dramatically under Alternative E. The number of exploration/delineation wells drilled would increase from 10 in Alternative B to 38, and as many as six might be drilled during a single winter season. This would increase the area of potential impact nearly 300 percent over Alternative B.

(b) Effects of Exploration Spills: These effects would be the same as those under Alternative B, except the possibility of impacts would be increased by almost 300 percent.

465

(c) Effects of Disturbance from Development: The types of oil and gas development activities that would occur under Alternative E would be the same as those that would occur under Alternative B. However, the level or intensity of these development activities would increase under Alternative E. The number of production pads would increase from two in Alternative B to six in Alternative E, and pipeline miles would increase by 130 for a total of 205 mi under Alternative E. Although difficult to quantify, the potential for the construction of pump stations, causeways, docks, and seawater pipelines also increases under Alternative E. Although unlikely, it also is possible that a causeway and/or dock be constructed along the coast. The possibility of a seawater pipeline also exists at about the same order of probability. All this activity dramatically increases the probability of potential impacts to cultural resources beyond that of Alternative B

(d) Effects of Development Spills: These effects would be the same as those under Alternative B, although the possibility of spills would be greatly increased.

Conclusion—First Sale: Alternative E opens all of the planning area to oil and gas leasing. Under Alternative E, impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature but may be significantly increased in magnitude over Alternative A. Under Alternative E, most of the impacts to cultural resources would result from oil and gas exploration and development, although there is a possibility that no such activities (except seismic reconnaissance) would impact cultural resources sites. When compared with Alternative B, the potential for impact to cultural resources would be significantly greater under Alternative E.

Multiple Sales: The potential impacts to cultural resources under Alternative E could inmcrease by as much as 400 percent compared to Alternative B.

Conclusion—Multiple Sales: Under Alternative E, potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under Alternative E, the potential impacts to cultural resources from oil and gas exploration and development would increase by at least 400 percent compared to Alternative B.

Effectiveness of Stipulations: The effectiveness of stipulations would be the same as under Alternative B.

13. Subsistence-Harvest Patterns: This section analyzes the impacts of ground-management actions and oil and gas leasing on the subsistence-harvest patterns of communities in or near the planning area. This analysis is organized by types of effects and discusses effects on subsistence-harvest patterns on each affected community as a result of disturbance and oil spills. Analytical descriptions of affected resources and species, a more in-depth discussion of the parameters for subsistence-harvest patterns impact analysis, as well as indigenous Inupiat knowledge concerning effects are described in more detail in the discussion for Alternative B (Sec. IV.C.13).

Under Alternative E, oil and gas leasing and development would be allowed in the entire planning area, making available to oil and gas leasing the Teshekpuk Lake Watershed, the high-value Goose Molting Habitat, Spectacled Eider Nesting Concentration, and Teshekpuk Lake Caribou Habitat LUEA's (4.66 million acres would be available to oil and gas leasing).

The Colville River would be available to oil and gas leasing, aboveground pipelines, and gravel extraction. Raptor, passerine, and moose areas on the Colville River and recreation and scenic areas would also be available (with certain restrictions) to oil and gas leasing and the siting of pipelines and roads. The BLM would recommend the Secretary of the Interior establish the Pik Dunes and the Ikpikpuk Paleontological Sites as special areas.

Leasing would be allowed on lands subject to pending Kuukpik Corporation conveyances, and royalties would be placed in escrow until Kuukpik entitlements were conveyed. Lease-specific stipulations to protect water quality; fish habitat; wetlands; and caribou-calving, -migration, and insect-relief areas. Specific stipulations for protecting subsistence harvest activities, particularly in the areas of monitoring impacts, access, conflict resolution, and protecting traditional sites would be in place to minimize impacts to these resources.

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Under Alternative E, ground-impacting-management actions are expected to increase significantly, and even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. Disturbance impacts from increased aircraft traffic associated with resource inventories and surveys to birds, caribou, moose, muskoxen, and other terrestrial mammals would cause brief disturbance reactions lasting from a few minutes up to an hour, potentially causing terrestrial mammals to avoid research, survey, and recreation camps during the summer-long field season. However, no overall increase is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area, even with this increased disturbance from aircraft flights. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil exploration activities—seismic activity and exploration drilling—would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads on low ground-pressure vehicles from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled at Camp Lonely, and moved inland the following winter. Umiat would also be used as a staging area. Seismic surveys would continue on the NPR-A, if a leasing program occurs. Under Alternative E, one to five fields with a resource range of 250 to 1,100 MMbbl of oil are estimated. Five to 15 exploration wells would be drilled. For development, 6 to 23 delineation and from 75 to 330 production and service wells would be drilled, and from 80 to 205 mi of pipeline constructed.

(a) Disturbance from Exploration and Development: Sources for disturbance from exploration and development essentially would be the same as those discussed for Alternative B, except for possible barge-resupply traffic. Because of projected summer supply-barge traffic in the open water, potential impacts from noise to migrating bowhead whales could occur, although normal migration would tend to keep the whales offshore and away from nearshore barge traffic. Overall, the chance of extensive fuel resupply by barge from this activity would be unlikely.

(b) Spills and Spill Cleanup: Under Alternative E, one to five fields with a resource range of 250 to 1,100 MMbbl of oil are estimated. Oil-spill-occurrence estimates over the assumed production life of the planning area range from 50 to 219 crude-oil spills, with a volume range from 200 to 876 bbl of oil (average spill size equals 4 bbl). For spills >1 bbl, the range is from 13 to 55 spills. For TAPS spills resulting from NPR-A production, the number of spills ranges from 4 to 15, with a volume ranging from 4 to 17 bbl. Oil-spill- occurrence estimate for TAPS tanker spills resulting from NPR-A resources is a 30- to 70-percent chance of 0 to 1 spills (with an average spill size of 30,000 gal) occurring. One-hundred-sixteen to 510 refined-oil spills (diesel fuel, aviation fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil), with an estimated volume ranging from 80 to 352 bbl (average spill size equals 29 gal) are estimated. Historically, by volume, diesel fuels account for 75 percent of the refined oil spills. All NPR-A scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. Adequate data are not available to estimate a chance of such an occurrence. Records indicate four pipeline leaks, with the largest discharge being 125 bbl. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would substantially affect the subsistence harvest (see Sec. IV.C.13, Subsistence).

Because of possible summer supply-barge traffic in the open water, potential impacts from noise and fuel spills to migrating bowhead whales could occur, although normal migration would tend to keep the whales offshore and away from nearshore barge traffic, and fuel resupply by barge is not expected to be the preferred scenario.

b. Effects on Subsistence Species:

(1) Terrestrial Mammals:

(a) Effects from Disturbance: For oil and gas activities, effects of Alternative E are expected to be significantly greater than those of Alternative B, with more helicopter disturbance of caribou and other terrestrial mammals. Increased habitat alteration would include the development of one to five oil fields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic. Surface, air, and foot traffic near the oilfields are expected to increase significantly and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. If a field is developed in TLH caribou-calving areas, some calving is expected to be displaced within 1.86 to 2.48 mi (3- 4 km) of roads and other production facilities over the life of the project. Caribou are expected to experience chronic, local effects but would not become unavailable, undesirable for use, or experience overall population reductions. However, there remains some risk of long-term effects, including overall population reductions (Secs. IV.C.9 and IV.F.9).

(b) Effects from Oil Spills: The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 to 2 years (Secs. IV.C.9 and IV.F.9).

(2) Fish:

(a) Effects from Disturbance: The individual effects of actions related to oil and gas development are the same for Alternative E as for Alternative B. However, the likelihood of their occurrence is estimated to be roughly five to six times higher for Alternative E than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effects of drill-pad, road, airstrip, and pipeline construction on arctic fish in Alternative E over that of Alternative B. Seismic surveys associated with Alternative E are expected to have the same overall effect on arctic fish as discussed for Alternative B (Secs. III.B.3, IV.C.7 and IV.F.7). Effects on fish resources from seismic and construction disturbance would increase under this alternative with increased ongoing, short-term impacts on the subsistence fisheries of Barrow and Nuiqsut; Atqasuk's subsistence fishery does not quite reach the western edge of the planning area.

(b) Effects from Spills: Oil spills and seismic surveys associated with Alternative E are expected to have the same overall effect on arctic fish as discussed for Alternative B (Secs. IV.C.7 and IV.F.7).

(3) Birds:

(a) Effects from Disturbance: Under Alternative E most disturbance effects, associated with ground transport, seismic surveys, exploratory drilling, and construction in winter, and moderate flight frequency supporting large and small camps and aerial surveys, moderate increases of boat traffic on the Colville River, air transport of recreational parties, development well drilling, and spill cleanup activities in summer are expected to be localized, to within several 100 yards to 0.6 mi (few 100 m-1 km) of the disturbing activity, and temporary, ranging from brief (<1 day) in the case of response to a few aircraft flights or presence of ground activity to 3 months or more for well drilling or ground transport operations. Recovery in these instances is expected to require no more than 1 year. More intense activity, such as substantially increased boat or foot traffic along rivers, still is expected to require no more than one season for recovery for most species (Secs. IV.C.8 and IV.E.8).

Overall disturbance effects to important subsistence species of feeding, molting, and nesting white-fronted geese, black brant, eiders, oldsquaw, and other species are expected to be localized (within 100 yards to 0.6 mi of the activity) and temporary (ranging from <1 day for aircraft flight to 3 months for well drilling and ground operations). Recovery in these instances is expected to require no more than 1 year.

(b) Effects from Spills: Oil or fuel spills entering lakes with staging waterfowl populations are expected to require no more than one season for recovery for most species. (Secs. IV.C.8 and IV.E.8).

(4) Bowhead Whales:

(a) Effects from Disturbance: The potential effects on bowhead whales from discharges and noise and disturbance are expected essentially to be the same under this alternative as under Alternative B (Secs. IV.C.10 and IV.F.10).

(b) Effects from Oil Spills: Under Alternative E, leasing in the entire planning area would create the potential for a fuel-oil spill from a supply barge transporting equipment to coastal staging areas. The possibility of a spill reaching migrating bowheads is minimal, as barge traffic would be nearshore, the migration offshore, and the size of the spill small. Additionally, fuel resupply by barge is not expected to be the preferred scenario. Small onshore spills are unlikely to reach the marine environment. Therefore, oil-spill effects on bowhead whales under Alternative E are expected to be same as Alternative B (Secs. IV.C.10 and IV.F.10).

(5) Other Marine Mammals:

(a) Effects from Disturbance: The effects on marine mammals of oil and gas activities for Alternative E are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects are expected to occur along the coast (Secs. IV.C.9 and IV.F.9).

(b) Effects from Oil Spills: For marine mammals, the effects of oil and gas activities for Alternative E are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential oil pollution effects is expected to occur along the coast (Secs. IV.C.9 and IV.F.9).

c. Effects on Communities: Effects on Barrow, Atqasuk, and Nuiqsut from oil-industry-development disturbance are discussed in detail in Section IV.B.10 of the Beaufort Sea Sale 170 FEIS (USDOI, MMS, In prep.). See previous discussions in this section of effects on caribou, the primary subsistence species, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals. Effects assessments from these sections are summarized below; for a synthesis of traditional knowledge (where available), see effects discussion for Subsistence under Alternative B (Sec. IV.C.13).

(1) Barrow, Atqasuk, and Nuiqsut—Effects from Disturbance and Spills: Ongoing, short-term, localized impacts from disturbance and oil spills would increase under Alternative E. Caribou could experience increased habitat alteration and some CAH and TLH caribou would experience disturbance and delays in their movements. Caribou displacement would increase near oil fields but there would be no significant effects to caribou populations. Fatalities and health effects from oil spills are expected to impact only a small number of terrestrial mammals and birds with recovery in 1 to 2 years. Increased effects to the TLH and CAH, other terrestrial mammals, fish, birds, and other marine mammals harvested by subsistence hunters from these three communities are not expected to have increased effects on overall subsistence harvests. No increases in effects are expected to bowhead whales. Under Alternative D, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be addressed by in-place stipulations.

(2) Other Communities—Effects from Disturbance and Spills: Other communities within or adjacent to the NPR-A are the Chukchi Sea villages of Point Lay and Wainwright to the west and the inland community of Anaktuvuk Pass to the south and east. Subsistence-harvest areas for these communities are not within or adjacent to the planning area, although recent research indicates that movement by the TLH does bring the herd into the traditional subsistence-harvest areas of the communities of Wainwright and Point Lay. Historically, Anaktuvuk Pass caribou hunters have ranged to the southerly boundary of the planning area, and movement by the TLH would bring it into the harvest area of Anaktuvuk Pass subsistence hunters as well, although they primarily hunt the WAH (and to a lesser extent the CAH). Short-term and localized impacts from disturbance and oil spills to the TLH and CAH would have no apparent impact on subsistence-caribou harvests for these three communities. Stipulations specific to this alternative further would minimize impacts to caribou.

Conclusion—First Sale: Overall effects associated with Alternative E on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative B. Some subsistence resources would be chronically impacted, but still no resource would become unavailable, undesirable for use, or experience overall population reductions. Overall, effects are not expected to have significant impacts on subsistence-harvest patterns in Barrow and Atqasuk, although oil-development activity under Alternative E could make Nuiqsut's pursuit of caribou more difficult for at least an entire harvest season.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative E increases from a range of 250 to 1,100 MMbbl in 1 to 5 oilfields to a range of 500 to 2,200 MMbbl in 2 to 10 oilfields. The number of exploration wells increase from a maximum of 15 to 60, delineation wells increase from a maximum of 23 to 48, and production wells increase from a maximum of 330 on 9 pads to 660 on 16 pads. Pipeline miles increase from 205 to 280 mi. Multiple sales would occur over a longer period of time and, depending on frequency of sales, the timeframe for oil and gas activities in the planning area would extend to at least 2 decades.

For Alternative E, it is estimated that the number of spills <1 bbl would increase from a range of 37 to 164 spills to a range of 75 to 329 spills, and the number of spills >1 bbl would increase from a range of 13 to 55 spills to a range of 25 to 109 spills over the assumed production life of the planning area. The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 50 to 219 spills to a range of 100 to 438 spills.

If several lease sales occur under Alternative E, considerably more exploration activity is expected to occur in the Teshepuk Lake calving habitat of the TLH caribou with the number of wells drilled increasing from 5 to 15 under the first sale to 15 to 60 under multiple sales. An increased potential displacement of calving TLH caribou along roads is expected between the increased number of production pads and other facilities. An increase in the number or miles of roads and other facilities with development under multiple sales is also expected to increase the impedance of TLH caribou movements to insect-relief areas along the coast, north of Teshekpuk Lake. The displacement of calving caribou represents a functional loss of habitat within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH. Small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B but with loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations. Effects on Arctic fish populations from additional sales from increases in the number of gravel pads are likely to have about twice the effect on arctic fish as discussed for Alternative E. Also, because the number of pipeline miles for multiple sales and Alternative E are similar, they are expected to have a similar effect as discussed for Alternative E. it is assumed that each additional sale would be expected to have a similar effect on arctic fish as described for Alternative E. However, if there were not enough time between sales to allow for full recovery, or if the level of activity for the selected alternative was greater than that of Alternative E, the effect of each additional sale on arctic fish is likely to be greater than that of Alternative E. An increase in effects to bird populations from increased noise disturbance could be expected with multiple sales, with corresponding increases in disturbance and local displacement, but recovery in these instances is still expected to require no more than 1 year. Oil spills entering larger lakes with larger numbers of molting or broodrearing geese and other species may result in losses in the hundreds, requiring several breeding seasons for recovery. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. For marine mammals, increased activity could result in an increase in aircraft disturbance of seals hauled out on the ice along the coast north of Teshekpuk Lake, and an increase in onshore surface traffic activity (seismic exploration, overland moves, construction activities along the coast) could result in more disturbance of polar bears denning and foraging along the coast. However, these effects are expected to be local and short term, with no significant adverse effects to the polar bear and seal populations as a whole. Small onshore spills are expected to have little effect on seals, walruses, and polar bears. If some of these spills occur in or contaminate streams in the Teshekpuk Lake area that drain into marine waters, small numbers of seals, polar bears, and other marine mammals might be exposed to contamination in nearshore habitats and suffer lethal or sublethal effects.

Conclusion—Multiple Sales: The effect of multiple sales under Alternative E is expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Based on the assumptions discussed in the text, each additional sale is expected to have similar effects on arctic fish as described for Alternative E. However, if there are increased levels of activity associated with future lease sales, and/or insufficient recovery time between sales, greater adverse effects than described for Alternative E are likely to occur. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. Multiple sales under Alternative E are expected to have similar effects to those under Alternative E in the first sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.F.7, Fish Resources, IV.F.8, Birds, IV.F.9, Mammals, and IV.F.10, Endangered and Threatened Species. The effectiveness of stipulations for protecting subsistence practices is the same as for Alternative B, most important of which is a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on NPR-A.

14. Sociocultural Systems: This discussion is concerned with those communities that could be impacted by ground-management actions and oil and gas leasing in the planning area. These communities are Barrow, Atqasuk, and Nuiqsut. Under Alternative E, oil and gas leasing and development would be allowed in the entire planning area, making available to oil and gas leasing the Teshekpuk Lake Watershed, the high-value Goose Molting Habitat, Spectacled Eider Nesting Concentration, Teshekpuk Lake Caribou Habitat, and Fish Habitat LUEA's (4.66 million acres would be available to oil and gas leasing). Lease-specific stipulations to protect water quality; fish habitat; wetlands; and caribou-calving, -migration, and insect-relief areas. Specific stipulations for protecting subsistence harvest activities, particularly in the areas of monitoring impacts, access, conflict resolution, and protecting traditional sites would be in place to minimize impacts to these resources.

The Colville River would be open to oil and gas leasing, aboveground pipelines, and gravel extraction. Raptor, passerine, and moose areas on the Colville River and recreation and scenic areas would also be open (with certain restrictions) to oil and gas leasing and the siting of pipelines and roads. The BLM would recommend the Secretary of the Interior establish the Pik Dunes and the Ikpikpuk Paleontological Sites as special areas. Leasing would be allowed on lands subject to pending Kuukpik Corporation conveyances, and royalties would be placed in escrow until Kuukpik entitlements were conveyed.

The primary aspects of the sociocultural systems covered in this analysis are (1) social organization and (2) cultural values, as described in Section III.C.3. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level, predominantly by industrial activities, increased population, increased employment, and effects on subsistence-harvest patterns associated with the sale. For a more in-depth discussion of the parameters for sociocultural effects analysis, see the discussion for Alternative B (Sec. IV.C.13).

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Under Alternative E, ground-impacting-management actions are expected to increase significantly, and even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. Disturbance impacts from increased aircraft traffic associated with resource inventories and surveys to birds, caribou, moose, muskoxen, and other terrestrial mammals would cause brief disturbance reactions lasting from a few minutes up to an hour, potentially causing terrestrial mammals to avoid research, survey, and recreation camps during the summer-long field season. However, no overall increase is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area, even with this increased disturbance from aircraft flights. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil exploration activities—seismic activity and exploration drilling—would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads on low ground-pressure vehicles from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled at Camp Lonely, and moved inland the following winter. Umiat would also be used as a staging area. Seismic surveys would continue on the NPR-A, if a leasing program occurs. Under Alternative E, one to five fields with a resource range of 250 to 1,100 MMbbl of oil are estimated. Five to 15 exploration wells would be drilled. For development, 6 to 23 delineation and from 75 to 330 production and service wells would be drilled, and from 80 to 205 mi of pipeline constructed.

(a) Disturbance from Exploration and Development: Sources for disturbance from exploration and development essentially would be the same as those discussed for Alternative B (Sec. IV.C.14, Sociocultural Systems).

(b) Spills and Spill Cleanup: See Section IV.F.13, Subsistence, for a discussion of Alternative E oil spills.

b. Population and Employment: Under Alternative E, oil and gas leasing in the planning area is projected to affect the population of the North Slope Borough through two types of effects on regional employment: (1) more petroleum-industry-related jobs as a consequence of planning area exploration and development and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (Sec. IV.B.11). Employment projections as a consequence of planning area activities are provided in Sec. IV.F.11. Throughout the development and production phase, total petroleum-related employment would range from 2,241 to 4,195 jobs during the peak development and production years between 2006 and 2014. Resident employment as a result of activities would range from 64 to 118 jobs during the period. Most workers are expected to permanently reside outside of the North Slope. Planning area oil and gas activities are projected to increase resident employment 4 to 8 percent during the development phase and 2 to 5 percent during the production phase above the declining existing-condition projections (Tables IV.F.11-1 and IV.F.11-2). Any development in the NPR-A under Alternative E is projected to increase the NSB population above the existing-condition level.

c. Subsistence-Harvest Patterns: Effects could be expected on subsistence-harvest patterns in the planning area as a result of disturbance to Barrow, Atqasuk, and Nuiqsut's subsistence harvests due to seismic disturbance, aircraft noise, supply-vessel traffic, onshore construction, and oil spills (see discussion for Alternative B, Sec. IV.C.14).

d. Effects on Barrow, Atqasuk, and Nuiqsut: This section analyzes effects of industrial activities, population and employment changes, and subsistence-harvest-pattern impacts on North Slope social organization, cultural values, and other issues. This discussion focuses on the North Slope as a whole and with a discussion for each community.

(1) Social Organization: The social organization of communities that might be affected by oil and gas activities in the planning area includes typical features of Inupiat culture: kinship networks that organize much of a community's subsistence- harvest, consumption, and sharing activities; informally derived systems of respect and authority; strong extended families (although not always living in the same household); stratification between families focused on success in the subsistence harvest; and access to subsistence technology (Sec. III.C.2). However, activities generated by oil and gas activities in the planning area are not likely to bring about the effects to these features in the communities in question (see discussion for Alternative B, in Sec. IV.C.13).

(2) Cultural Values: Cultural values and orientations (as described in Sec. III.C.2) can be affected by changes in the population, social organization and demographic conditions, economy, and alterations of the subsistence cycle. Of these, the only changes that could be expected to occur would be in Nuiqsut's social organization and the subsistence cycle in Barrow, Atqasuk, and Nuiqsut (see discussion for Alternative B, Secs. IV.C.13 and IV.C.14; and Sec. IV.F.14).

Chronic, short-term, localized impacts from disturbance and oil spills would increase under Alternative E. Caribou could experience increased habitat alteration and some CAH and TLH caribou would experience disturbance and delays in their movements. Caribou displacement would increase near oil fields but there would be no significant effects to caribou populations. Fatalities and health effects from oil spills are expected to impact only a small number of terrestrial mammals and birds with recovery in 1 to 2 years. Increased effects to the TLH and CAH, other terrestrial mammals, fish, birds, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters are not expected to have increased effects on the overall subsistence harvests for these communities. No increases in effects are expected to bowhead whales. Under Alternative E, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be addressed by in-place stipulations.

Overall effects associated with Alternative E on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative B. Subsistence resources would be chronically impacted, but still no resource would become unavailable, undesirable for use, or experience overall population reductions. Overall, effects are not expected to have significant impacts on subsistence-harvest patterns in Barrow and Atqasuk, although oil-development activity under Alternative E could make Nuiqsut's pursuit of caribou more difficult for at least an entire harvest season.

(3) Social Health: Effects on sociocultural systems often can be seen in rising rates of mental illness, substance abuse, and violence. This has proven true for Alaskan Natives who have been faced since the 1950's with increasing acculturative pressures. The rates of these occurrences far exceed those of other American populations such as Alaskan non-Natives, American Natives, and other American minority groups (see discussion for Alternative B, Sec. IV.C.13). Although there may be additional reasons for differences in social problems in local communities, it is clear that the proximity to industrial enclaves enables residents easier access to drugs and alcohol, thereby affecting the social health of the community—a situation that could intensify in Nuiqsut as a result of NPR-A oil and gas activity. Any effects on social health would have ramifications in the social organization, but NSB Native communities have, in fact, proven quite resilient to such effects by local voter insistence on these communities being "dry" and by the NSB's continued support of Inupiat cultural values and its strong commitment to health, social services, and other assistance programs.

Nuiqsut is the most likely community in the region to experience additional sale-related effects in social health and well-being. These effects on social health could have direct consequences on the sociocultural system but would not have a tendency toward displacement of existing institutions above the displacement that already has occurred with the current level of development. Effects on the institutions and sociocultural systems in Barrow and Atqasuk would be periodic but not displace existing institutions.

Conclusion—First Sale: Effects from management actions and oil and gas activities in the planning area under Alternative E are unlikely to disrupt sociocultural systems. Disturbance effects would be short term and would not be expected to disrupt or displace institutions and sociocultural systems, community activities and traditional practices for harvesting, sharing, and processing subsistence resources. Periodic disruptions to subsistence resources could occur, but any disruptions that occurred from oil and gas activities potentially would be mitigated by BLM in-place stipulations and mitigation measures designed to protect caribou, waterfowl, fish, moose resources, and specifically subsistence resources, subsistence practices, and hunter access. Overall effects under Alternative E to the sociocultural systems of the communities of Barrow, Atqasuk, and Nuiqsut would increase over those in Alternative B, but there would continue to be no disruption or displacement of cultural institutions or sociocultural systems.

Multiple Sales: If several lease sales occur under Alternative E, considerably more exploration activity is expected to occur in the planning area, and the levels of effects due to noise, disturbance, and habitat alteration are expected to increase. Given that resource estimates and development scenarios project an increase in resources and a large increase in the number of drill pads and pipeline miles, logic would assume a large increase in the effects to potentially affected subsistence resources, except for the fact that these effects would be spread over 2 decades. The critical factor would be the timing between sales—a longer interval would allow more recovery to subsistence resources from aircraft, vehicular, and construction disturbance and subsistence practices from increased access conflicts; less of an interval might not allow for sufficient recovery. In any case, the cumulative effect clearly would be an increased development "footprint" and consequent increased habitat loss to resources and use loss to hunters. This could affect subsistence harvests in the communities of Barrow, Atqasuk, and (especially) Nuiqsut and could alter caribou distributions sufficiently to make subsistence-hunter access more difficult.

Conclusion—Multiple Sales: Effects from management actions and oil and gas activities in the planning area for multiple sales under Alternative E could disrupt sociocultural systems for periods up to 1 year, but impacts would not be expected to displace institutions and sociocultural systems, community activities, or traditional practices for harvesting, sharing, and processing subsistence resources, the same level of effect anticipated for multiple sales under Alternative B.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.F.7, Fish Resources, IV.F.8, Birds, IV.F.9, Mammals, and IV.F.10, Endangered and Threatened Species. The effectiveness of stipulations for protecting subsistence practices and sociocultural systems is the same as for Alternative B, most important of which being a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on the NPR-A.

15. Coastal Zone Management: Under Alternative E, all BLM-administered lands in the planning area would be available to oil and gas leasing (4.6 million acres). Aboveground pipelines could cross all lands within the planning area, and all lands would be available for seismic studies. These areas are subject to restrictions for siting pipelines and industrial structures. The Colville River in the planning area would be recommended and managed as a "recreational" river in the WSR System. Other protections include adding a Bird Conservation Area along the Colville River; designating the Ikpikpuk Paleontological Sites LUEA as a new Special Area to protect paleontological resources; and adding the Pik Dunes LUEA to the Teshekpuk Lake Special Area.

Federal lands within the NPR-A are excluded from the coastal zone; however, all uses and activities on Federal lands either occurring within the coastal zone or that may reasonably be expected to affect the coastal area and its resources must be consistent to the maximum extent practicable with enforceable standards of the ACMP, including State standards in 6 AAC 80 and enforceable policies of local district programs. The enforceable policies of the NSBCMP have been incorporated within the zoning ordinance in Section 19.70.050. The primary goal of the NSB's land management regulations and zoning ordinances is to protect the subsistence lifestyle of the Borough's largely Inupiat population, while also encouraging and managing economic development.

a. Activities Other than Oil and Gas Exploration and Development: The level of activities other than oil and gas would be similar to or slightly greater for Alternative E than for Alternative A (Table IV.A.1.a-1). Although use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. Disturbance impacts from increased aircraft traffic associated with resource inventories and surveys to birds, caribou, moose, muskoxen, and other terrestrial mammals would cause brief disturbance reactions lasting from a few minutes up to an hour, potentially causing terrestrial mammals to avoid research, survey, and recreation camps during the summer field season. No overall increase is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area, even with this increased disturbance from aircraft flights.

b. Oil and Gas Exploration and Development Activities: Under Alternative E, the impacts of disturbance from oil and gas exploration and development activities are expected to increase significantly over those under Alternative B. Under Alternative E, oil exploration activities, including seismic activity and exploration drilling, would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads on low ground-pressure vehicles from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled at Camp Lonely, and moved inland the following winter. Umiat would also be used as a staging area. Seismic surveys would be allowed in the entire planning area. Under Alternative E, one to five fields with a resource range of 250 to 1,100 MMbbl of oil are estimated. Five to 15 exploration wells would be drilled. For development, 6 to 23 delineation and from 75 to 330 production and service wells would be drilled, and from 80 to 205 mi of pipeline constructed.

Effects of Exploration and Development on the Alaska CMP: Under alternative E, all BLM-administered lands would be available for leasing. Potential conflicts with coastal management standards under Alternative E could occur in three main areas: under the habitat, subsistence, and water quality standards of the ACMP. Sources for disturbance from oil and gas exploration and development activities essentially would be the same as those discussed for Alternative B, except for possible barge-resupply traffic. Chronic, short-term, localized impacts from disturbance and oil spills would increase under Alternative E.

Effects of disturbance from oil and gas exploration and development activities essentially would be the same as those discussed for Alternative B, except for possible barge-resupply traffic. Under Alternative E, one to five fields with a resource range of 250 to 1,100 MMbbl of oil are estimated. Oil-spill-occurrence estimates over the assumed production life of the planning area range from 50 to 219 crude-oil spills, with a volume range from 200 to 876 bbl of oil (average spill size equals 4 bbl). For spills <1 bbl, the range is from 13 to 55 spills. For TAPS spills resulting from NPR-A production, the number of spills ranges from 4 to 15, with a volume ranging from 4 to 17 bbl. Oil spill occurrence estimates for TAPS tanker spills resulting from NPR-A resources is a 30- to 76-percent chance of 0 to 1 spills (with an average spill size of 30,000 gal) occurring.. All NPR-A scenarios call for an onshore pipeline for oil delivery to the TAPS, and there is the potential for a pipeline spill contaminating the Colville River. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would substantially affect the subsistence harvest (Sec. IV.C.13).

For oil and gas activities, effects of Alternative E on caribou and other terrestrial mammals are expected to be significantly greater than those of Alternative B, with more helicopter disturbance of caribou and other terrestrial mammals. Increased habitat alteration would include the development of one to five oil fields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic. Surface, air, and foot traffic near the oilfields is expected to increase significantly and to displace some terrestrial mammals, but not significantly affect Arctic Slope populations. If a field is developed in TLH caribou-calving areas, some calving is expected to be displaced within 1.86 to 2.48 mi (3-4 km) of roads and other production facilities over the life of the project. Caribou are expected to experience chronic, local effects but would not become unavailable, undesirable for use, or experience overall population reductions; however, some risk of long-term effects and overall population reductions remain. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 to 2 years (Secs. IV.C.9 and IV.F.9).

The individual effects of disturbance on fish from actions related to oil and gas development are the same for Alternative E as for Alternative B. However, the likelihood of their occurrence is estimated to be roughly five to six times higher for Alternative E than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effects of drill-pad, road, airstrip, and pipeline construction on arctic fish in Alternative E over that of Alternative B. Effects on fish resources from seismic and construction disturbance would increase under this alternative with increased chronic, short-term impacts on the subsistence fisheries of Barrow and Nuiqsut. Oil spills and seismic surveys associated with Alternative E are expected to have the same overall effect on arctic fish as discussed for Alternative B (Secs. IV.C.7 and IV.F.7).

Under Alternative E, most disturbance effects to birds and important subsistence species of feeding, molting, and nesting white-fronted geese, black brant, eiders, old squaw, and other species are expected to be localized and temporary, ranging from brief (<1 day) in the case of response to a few aircraft flights or presence of ground activity to 3 months or more for well drilling or ground transport operations. These disturbance effects are associated with ground transport, seismic surveys, exploratory drilling, and construction in winter, and moderate flight frequency supporting large and small camps and aerial surveys, moderate increases of boat traffic on the Colville River, air transport of recreational parties, development well drilling, and spill cleanup activities in summer. Recovery in these instances is expected to require no more than 1 year. Oil or fuel spills entering lakes with staging waterfowl populations are expected to require no more than one season for recovery for most species (Secs. IV.C.8 and IV.F.8).

The potential effects on bowhead whales from discharges and noise and disturbance are expected essentially to be the same under Alternative E as under Alternative B. Leasing in the entire planning area would create the potential for a fuel-oil spill from a supply barge transporting equipment to coastal staging areas. The possibility of a spill reaching migrating bowheads is minimal, as barge traffic would be nearshore, the migration offshore, and the size of the spill small. In addition, fuel resupply by barge is not expected to be the preferred scenario. Small onshore spills are unlikely to reach the marine environment. Therefore, oil-spill effects on bowhead whales under Alternative E are expected to be same as Alternative B (Secs. IV.C.10 and IV.F.10).

474

The effects from disturbance and oil spills from oil and gas activities on marine mammals for Alternative E are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects are expected to occur along the coast, some increase in potential oil pollution effects is expected to occur along the coast (Secs. IV.C.9 and IV.F.9).

Ongoing, short-term, localized impacts from disturbance and oil spills on subsistence hunting activities to the communities of Barrow, Atqasuk and Nuiqsut would increase under Alternative E. Caribou could experience increased habitat alteration and some CAH and TLH caribou would experience disturbance and delays in their movements. Caribou displacement would increase near oil fields but there would be no significant effects to caribou populations. Fatalities and health effects from oil spills are expected to impact only a small number of terrestrial mammals and birds with recovery in 1 to 2 years. Subsistence-hunter concerns about access to resources and resource contamination under this alternative would be addressed by special stipulations developed to provide maximum protection to the resources (see effectiveness of stipulations).

Potential conflict between Alternative E proposed activities and Statewide standards and NSB district policies could occur, in conjunction with the NSB CMP 2.4.5.2(h) (NSBMC 19.70.050.K.8) that relates to both subsistence and cultural resource areas. This policy requires that development be located, designed, and maintained so as not to interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence-use areas. Also, conflict with district policies could occur in the potential for adverse effects to subsistence resources. NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) relates to "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems." In addition, the NSB communities have expressed concern with restrictions to recreation activities. Potential conflicts with these standards is anticipated, but effects will be minimized by stipulations developed for this lease sale.

Conclusion—First Sale: Under Alternative E, conflicts could occur with the habitat, subsistence, and water quality standards of the ACMP. Overall effects of oil and gas activities for Alternative E are expected to significantly increase effects to terrestrial mammals, marine mammals, and subsistence resources and activities of local communities, over the effects of Alternative B. Conflicts could occur with specific Statewide standards and NSB CMP policies related to the potential for user conflicts between development activities and access to subsistence resources, and to adverse effects on subsistence resources. These effects would occur in the event of spilled oil contacting subsistence resources and habitats, and the activities associated with oil-spill cleanup. Overall effects associated with Alternative E on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative B. Subsistence resources would be chronically impacted, but still no resource would become unavailable, undesirable for use, or experience overall population reductions. Overall, effects are not expected to have significant impacts on subsistence-harvest patterns in Barrow and Atqasuk, although oil-development activity under Alternative E could make Nuiqsut's pursuit of caribou more difficult for at least an entire harvest season.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative E increases from a range of 250 to 1,100 MMbbl in 1 to 5 oilfields to a range of 500 to 2,200 MMbbl in 2 to 10 oilfields. The number of exploration wells increase from a maximum of 15 to 60, delineation wells increase from a maximum of 23 to 48, and production wells increase from a maximum of 330 on 9 pads to 660 on 16 pads. Pipeline miles increase from 205 to 280 mi. Multiple sales would occur over a longer period of time and, depending on frequency of sales, the time frame for oil and gas activities in the planning area would extend to at least 2 decades. The number of spills <1 bbl would increase from a range of 37 to 164 spills to a range of 75 to 329 spills, and the number of spills >1 bbl would increase from a range of 13 to 55 spills to a range of 25 to 109 spills over the assumed production life of the planning area. The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 50 to 219 spills to a range of 100 to 438 spills.

Effects of oil and gas activities under multiple sales are expected to increase over those for one sale under Alternative E, and potential conflicts with the habitat, subsistence, and water quality standards of the ACMP could occur. If several lease sales occur under this alternative, considerably more exploration activity is expected to occur in the Teshekpuk Lake calving habitat of the TLH caribou with the number of wells drilled increasing from 5 to 15 under the first sale to 15 to 60 under multiple sales. An increased potential displacement of calving TLH caribou along roads is expected between the increased number of production pads and other facilities. An increase in the number or miles of roads and other facilities with development under multiple sales is also expected to increase the impedance of TLH caribou movements to insect-relief areas along the coast, north of Teshekpuk Lake. The displacement of calving caribou represents a functional loss of habitat within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH. Small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B but with loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations.

Effects on Arctic fish populations from additional sales from increases in the number of gravel pads are likely to have about twice the effect on arctic fish as discussed for Alternative E. Also, because the number of pipeline miles for multiple sales and Alternative E are similar, they are expected to have a similar effect as discussed for Alternative E. However, if there were not enough time between sales to allow for full recovery, or if the level of activity for the selected alternative was greater than that of Alternative E, the effect of each additional sale on arctic fish is likely to be greater than that of Alternative E. An increase in effects to bird populations from increased noise disturbance could be expected with multiple sales, with corresponding increases in disturbance and local displacement, but recovery in these instances is still expected to require no more than 1 year. Oil spills entering larger lakes with larger numbers of molting or brood rearing geese and other species may result in losses in the hundreds, requiring several breeding seasons for recovery. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. For marine mammals, increased activity could result in an increase in aircraft disturbance of seals hauled out on the ice along the coast north of Teshekpuk Lake, and an increase in onshore surface traffic activity (seismic exploration, overland moves, construction activities along the coast) could result in more disturbance of polar bears denning and foraging along the coast. However, these effects are expected to be local and short term, with no significant adverse effects to the polar bear and seal populations as a whole. If some of these spills occur in or contaminate streams in the Teshekpuk Lake area that drain into marine waters, small numbers of seals, polar bears, and other marine mammals might be exposed to contamination in nearshore habitats and suffer lethal or sublethal effects.

Conclusion—Multiple Sales: Effects from multiple sales under Alternative E are expected to result in potential conflict with the habitat, subsistence, and water-quality standards of the ACMP. The effect of multiple sales under Alternative E is expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oilfields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Additional sales are expected to have similar effects on arctic fish as described for Alternative E. However, if there are increased levels of activity associated with future lease sales, and/or insufficient recovery time between sales, greater adverse effects than described for Alternative E are likely to occur. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to have similar effects to those under Alternative E in the first sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Effectiveness of Stipulations: Stipulations described in Section II were developed to provide maximum protection to all high-value resources within the NPR-A, particularly under Alternative E, where all BLM-administered lands are available for leasing. Under Alternative E, all stipulations identified in Section II would be adopted and required for any oil and gas exploration, development, or production activities, including seismic activities. Lease-specific stipulations to protect water quality; fish habitat; wetlands; and caribou calving, caribou migration, and caribou insect relief areas; and subsistence resources and access would be in place to minimize impacts to these resources. Stipulations regarding solid- and liquid-waste disposal, fuel handling, and spill cleanup are expected to reduce the potential effects of spills and human refuse on terrestrial mammals. Stipulations on overland moves and seismic work are expected to minimize alteration of terrestrial mammal habitats. The stipulation requiring aircraft to maintain a 1,000-ft AGL (except for takeoffs and landings) over caribou winter ranges from October through May 15, and to maintain a 2,000-ft AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, is expected to minimize disturbance of caribou.

The stipulations related to oil and gas exploration and development, including facility design and construction restrictions, and restrictions on the use of oilfield roads and airstrips for public use are expected to minimize alteration of terrestrial mammal habitat and interference with caribou movements. Stipulations that restrict permanent surface occupancy of oil and gas facilities within 2 mi of the coast and east of Teshekpuk Lake to Kogru Inlet are expected to reduce disturbance and interference with caribou movements, particularly, the movements of caribou to and from the coast for insect relief and the movements of TLH cow caribou to calving habitats north of the lake. Stipulations requiring elevated pipelines and roads be separated at least 500 ft and to place pipelines on the appropriate side of the road (depending on general movements of caribou in the area) could significantly reduce interference with caribou movements. A stipulation prohibiting permanent surface occupancy other than buried pipelines within the two narrow land corridors identified as crucial caribou movement corridors between Teshekpuk Lake and the Beaufort Sea would further reduce or avoid interference with THL caribou movements (Fig. III.B.5.a-1). Implementation of all the above stipulations would reduce but not eliminate all effects on TLH caribou. Some level of displacement of calving still is expected to occur with 1.86 to 2.48 mi (3-4 km) of oilfield roads, and some caribou movements during insect harassments would be temporarily disrupted when caribou encounter road and foot traffic in association with production facilities. These disruptions would have some adverse energetic effects on individual caribou.

The stipulations having the most beneficial effect on arctic fish are the same as those discussed for Alternative B. However, due to the increased level of potential oil and gas activity associated with Alternative E over that of Alternative B, the absence of these stipulations may increase adverse effects on arctic fish populations. Several stipulations were developed to provide protection for birds.

For example, disturbance of birds from ground transportation and other activities including oil and gas activities would be mitigated, and essential habitat protected, by Stipulations 20b through m, minimizing and seasonally restricting vehicle use and seismic activity, and taking recommended precautions in Goose Molting and Colville River LUEA's (geese, raptors, passerines affected). Stipulations 21 and 33 require seasonal restrictions on drilling and major construction (geese, shorebirds). Stipulations 22, 25, and 31 require avoidance of lakeshore margins for oil and gas activities, avoidance of lake margins, and establish a facility buffer around high-use lakes (geese, shorebirds). Stipulations 29 and 32 require consolidation/integration oil and gas facilities, and incorporate visual screening features for facilities near goose molting lakes (geese). Stipulations 38, 39, and 44 establish facility setbacks along specified lakes and streams, facilities and mining sites located out of floodplains and 500 ft from lake basins, and no long-term occupancy of Colville River LUEA (raptors, passerines, loons, brood-rearing waterfowl). Stipulations 50 and 51 require seasonal restrictions of oil and gas ground traffic in Goose Molting LUEA and stockpiling major oil and gas equipment and materials (geese, shorebirds). Aircraft disturbance of birds would be mitigated by Stipulations 54 and 55, which require seasonal restrictions of oil and gas helicopter overflights and BLM authorized fixed-wing flight frequency in the Goose Molting LUEA (geese shorebirds), and 56 and 57, which require maintenance of seasonal minimum flight altitudes over the Teshekpuk Lake and Colville LUEA's (loons, geese, shorebirds, raptors, passerines). Other potentially adverse situations would be mitigated by Stipulations 7 and 10, immediate cleanup of fuel spills using ADEC-approved materials stored at all fueling and maintenance areas. Stipulation 11 requires fuels stored in lined/diked areas at least 100 ft from lakes and streams (loons, waterfowl, shorebirds, passerines), preparing a hazardous materials contingency plan for large fuel transport (loons, geese, shorebirds); Stipulation 18 restricts removing quantities of water from lakes that do not alter the lakes used by molting geese (geese, loons, shorebirds); Stipulation 1 requires precautions be taken to avoid attracting wildlife (predators) to refuse (most birds); Stipulation 70 prohibits public access to the Goose Molting LUEA through oil fields prohibited (geese, loons shorebirds, passerines); and Stipulation 59, removal of gravel fill so as to prevent enhanced access to the Goose Molting LUEA (geese, loons). These stipulations would minimize disturbance from most factors and prevent fuel or oil spilled on pads from reaching surrounding habitats.

The effectiveness of mitigating measures for protecting bowhead whales and other endangered species from noise and disturbance from oil and gas activities is the same as Alternative B; and from activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, the same as Alternative A. For marine mammals, the effectiveness of stipulations is expected to be the same as under Alternative A.

The effectiveness of stipulations described above for protecting biological resources and habitat and for subsistence activities would reduce potential conflicts with the habitat and subsistence standards of the ACMP and NSB CMP policies.

16. Recreation and Visual Resources:

a. Activities Other than Oil and Gas Exploration and Development:

Disturbance: The kinds of activities other than oil and gas expected under Alternative E are the same as under Alternative A. However, certain of these activities would increase as a result or in support of oil and gas development. For example, field activities associated with archeological site clearances such as camps, excavations, and aircraft activity all likely would increase. Impacts would be minimal and short term in nature as described under Alternative A, but the total area impacted could increase to 3,000 acres (from 1,500 in Alternative A).

Although the amount of supplies and material transported by winter overland moves may increase under this alternative, these moves generally follow the same route. Therefore, neither the length nor number of green trails is expected to noticeably increase from Alternative A.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: The types of oil and gas exploration activities that would occur under Alternative E are similar to those under Alternative B. However, the level of some of these exploration activities would increase compared to Alternative B, i.e., additional seismic survey operations are expected, the number of exploration delineation wells drilled at any one time would increase from 1 to 4, and the total number of these wells would increase from 10 to 28. Consequently, short-term impacts from ongoing seismic activity could increase from 500 acres affected under Alternative A and 1,000 acres under Alternative B to 2,000 to 2,500 acres affected under Alternative E. The area that could be impacted during drilling operations would increase from approximately 8,000 to 32,000 acres (winter only). Accumulating summer-season visual impacts from the greening of ice pads, roads, and airstrips would increase from about 500 acres (under Alternative B) to 1,900 acres. Several hundred miles of lineal green trails also would be visible from the air as a result of seismic operations; the number of miles visible would increase from Alternative B in direct relationship to increased seismic operations.

(2) Development: The types of oil and gas development activities that would occur under Alternative E are similar to those under Alternative B. However, the number of production pads is anticipated to increase from two (under Alternative B) to six; the number of miles of (oil) pipeline is expected to increase from 75 mi (under Alternative B) to 205 mi with an additional 15 mi of "water injection" pipeline expected, and the number of pump stations will increase to two under Alternative E. Consequently under this alternative, there would be a long-term loss of scenic quality, solitude, naturalness, or primitive unconfined recreation over an area of approximately 228,000 acres (i.e. [8,000 acres/pad x 6 pads] + [8,000 acres/pump station x 2 pump stations] + [640 acres/mi x 220 mi of pipeline]). This is about 156,600 acres more than under Alternative B.

Effects of Spills: The effects of spills would be the same as analyzed for Alternative B.

Impacts to Wild and Scenic River Values: Under this alternative, outstandingly remarkable river values along the Colville River would not receive any special protection under the WSR Act. Protection of these resources would be consistent with the provisions of the NPRA, Alternative E management objectives and as a result of project specific NEPA analysis. Accordingly, some impacts to outstandingly remarkable values could occur along certain portions of the river corridor. This is especially true along those portions of the Colville where oil and gas values are high. Development in these river segments could diminish the likelihood that these segments of the river would meet criteria for designation as a "wild" river. It is not likely that anticipated development would diminish outstandingly remarkable river values to the point that these segments of the river could not be designated as recreational.

Conclusion—First Sale: As compared to Alternative A, there will be an increase of approximately 1,500 acres to 3,000 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. As compared to Alternative B, short-term impacts from ongoing oil and gas exploration activities would increase from approximately 9,000 acres to 34,000 to 34,500 acres in short-term impacts from active drilling operations. The greening of vegetation from ice pads, roads, airstrips, and compacted snow would increase to about 1,900 acres, a 1,400-acre increase from Alternative B. Oil and gas development would result in a long-term loss of scenic quality, solitude, naturalness, or primitive unconfined recreation over an area of approximately 228,600 acres (or 5.0% of the planning area) for the life of production fields and pipelines. This is 156,600 acres more than under Alternative B.

Multiple Sales: The types of impacts resulting from additional lease sales will be the same as described above for the first sale. Short-term impacts such as green trails and disturbance resulting from noise, aircraft, and other on-going activities would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would accumulate to the extent such facilities are necessary to support additional exploration and production. It is anticipated that such facilities will increase about 51 percent over that needed for a single sale and affect a total of approximately 307,000 acres.

Conclusion—Multiple Sales: Long-term impacts would accumulate and increase about 51 percent above those of the first sale, ultimately affecting approximately 307,000 acres or about 6.7 percent of the planning area.

Effectiveness of Stipulations: The Upper Colville River upstream from about Umiat would be designated Visual Management Class II under this alternative. As such, no permanent visible structures would be allowed in this important recreation and scenic Class A area. The Colville River from about Umiat to Ocean Point, a scenic Class B area and also an important recreation area, would be managed as a Visual Management Class III area. Under Class III guidelines, construction may be visible but should not dominate the landscape. Mitigation required to meet the standards established by these management classes should prevent any significant long-term impacts to visual/recreation values in these two highly scenic and important recreation areas.

Under this alternative, the Kuukpik and Intensive Subsistence LUEA's would be managed as Visual Management Class IV areas rather than Class III areas—the same as under Alternative B. Under Class IV guidelines, construction may dominate the landscape in terms of scale. This would result in less aggressive efforts to mitigate visual impacts. An aboveground pipeline through this area may exceed Class III standards. The remaining planning area is designated Visual Management Class IV, the same as under Alternative B.

As under other alternatives, impacts to recreation values from exploratory oil and gas activities and from overland moves are significantly reduced by restricting these activities to winter months. Few recreationists visit the area during winter months.

479

BLANK PAGE

G. EFFECTS OF THE CUMULATIVE CASE:

The analysis for the cumulative case is based on the potential effects associated withexploitation of known or estimated petroleum resources from current and reasonably foreseeable onshore and offshore State and/or Federal leases. This section focuses on those oil and gas projects that can be hypothesized to have some reasonable chance of occurrence during the life of the proposed planning effort; crude-oil resource estimates are shown in Table IV.A.5-1. Each of the analysts contributing to this EIS also may focus on other issues that they feel to be particularly germane to their resource topics.

In analyzing the cumulative case for the Northeast NPR-A Planning Area, consideration is given to the potential effects on (1) the physical and biological resources, sociocultural systems, and various programs from activities associated with petroleum exploration, development and production, and transportation in the planning area and the major projects discussed in Section IV.A.5 and (2) migratory species from activities over their range, including the transportation of oil from Valdez, Alaska, to the U.S. West Coast. Migratory species includes those species or species groups that migrate to and from Alaska and migratory as well as other species in other areas that might be affected by the transportation of Alaska North Slope crude oil—especially oil spilled along pipeline and marine tanker-transportation routes. (Alaska North Slope crude oil includes oil produced from both onshore and offshore fields north of the Brooks Range and would include any oil that might be produced in the planning area.)

Oil exploitation in the planning area would increase the level or activities affecting the environment and it resources. Under Alternative E 500 to 2,200 MMbbl (Table IV.A.1.b-6) may be explored and developed as the result of multiple oil and gas lease sales in the planning area over a period of time that might be measured in decades. The level of activities associated with such development are shown in Table IV.A.1.b-7. Oil resource estimates for western NPR-A range from 0.13 to 1.2 Bbbl (Table IV.A.5-1). The total amount of oil produced from onshore fields north of the Brooks Range and offshore fields in the Beaufort Sea is estimated to range from 7.85 to 15.95 Bbbl (Table IV.A.5). Potential oil production from the planning area represents about 3 to 7 percent of the total estimated Alaska North Slope crude-oil production.

As noted in Section IV.A, any economically recoverable oil that might be discovered in the planning area would be transported through pipeline(s) to existing infrastructure associated with North Slope petroleum development, mixed with crude oil from other sources, and transported overland via the TAPS to Valdez for transshipment via tankers mainly to the U.S. West Coast refineries; a fraction of Alaska North Slope crude oil also is shipped to a refinery at Nikiski, Alaska, and to refineries located in the Far East.

Table IV.G-1
New Cumulative Onshore Area (Acres) Affected by Gravel Extraction and Fill for Existing Oil Fields and Planned Projects on the North Slope

	Reserve Pits		Gravel Mines[1]		Gravel Roads, Pads, and Airstrips[2]	Total Area of Gravel Extraction and Fill
	Number	Acres	Number	Acres	Acres	Acres
Existing Oil Field Units						
Prudhoe Bay	106	590	6	726	4,590	5,316
Lisburne	10	16	0	0	213	213
Endicott Duck Island	0	0	1	179	392	571
Niakuk	0	0	0	0	22	22
Milne Point	20	19	1	43	205	248
Point McIntyre	0	0	0	0	33	33
Kuparuk	128	131	5	564	1,435	1,999
Total	262	756	13	1,512	6,890	8,402
Planned Projects						
Cascade Development	0	0	0	0	31	31
Badami Development	0	0	1	89	85	174
Nuiqsut (BIA) Road	0	0	0	0	26	26
ADP Development	0	0	0	0	97	97
Nuiqsut Mine-Phase 1	0	0	1	50	0	50
Tarn	0	0	0	0	74	74
Total	0	0	2	139	313	452

Source: Data for existing oilfields provided by BP Exploration; data for planned projects were taken from their respective environmental documents.

[1] Including mine pit excavations, overburden stockpiles, and access roads.

[2] Including reserve pit areas (planned projects do not have reserve pits).

1. Soils: In addition to the alternatives presented in this document, other activities associated with the cumulative case that may impact soils include Federal and State offshore oil development (by supporting infrastructure onshore), State and private onshore oil development, and oil transportation. All of these activities impact soils through the development of infrastructure.

Impacts on soils are closely related to surface activities and disturbance of the vegetative cover. The more extent and severity of disturbance to vegetation, the more serious will be the impacts on soils. Therefore, for each of these considerations, please refer to the analysis for vegetation. The recovery of soils is slower than that of vegetatation; it may take from several years to many decades for soils recovery.

Mitigation requires that there always be full stipulation (Stipulation 71) compliance throughout all phases of developments: exploration, design, construction, operations and maintenance, termination, restoration and abandonment.

Conclusion: Estimated areas of impacts and losses of soils from all activities are similar to those areas discussed under Vegetation, Section IV C.6.

2. Paleontological Resources: In general, cumulative impacts to paleontological resources would result from development and production activities rather than exploration activities. However, paleontological resources are not ubiquitous as is the case with wildlife, habitat, or scenic value, and it is possible that paleontological resources might not be impacted by petroleum-related activities. If they occur, it is probable that significant cumulative impacts would be greatest in areas of high oil and gas potential.

Conclusion: Overall, cumulative impacts would be most probable and similar in nature and intensity to those described in Alternative I.

3. Water Resources: The cumulative effects of oil and gas exploration and development would result from disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst), blockages of natural channels and floodways that disrupt drainage patterns, increased erosion and sedimentation, and removal of gravel from riverine pools and lakes, as noted in Section IV C.3. The cumulative case assumes exploration and development of all the planning noted for the planning area (maximum) in Table IV A.5. Thus, the effects of oil and gas exploration and development in the planning area are likely to be greater than those estimated for Alternative E. Also, the cumulative case considers the other projects listed in Section IV A.5. Thus, the effects on water resources may be several times greater than estimated for Alternative E.

The long-term effect of thermokarst on water resources in the planning area would be subsidence of the ice-rich permafrost along the stream banks and lakeshores, especially in areas where the wave action of the water will accelerate the removal of the degrading protective cover. Fine-grained sediments melting out of the ice-rich permafrost result in increased sediment erosion and changes to stream channel and bed morphology.

Natural drainage patterns can be disrupted when activities or structures divert, impede, or block flow in stream channels, lake currents, or shallow-water tracks. Blockages or diversions to areas with insufficient flow capacity can result in seasonal or permanent impoundments. Diverting stream flow or lake currents also can result in increased bank or shoreline erosion and sedimentation as well as potential thermokarst.

Besides thermokarst and drainage alteration, erosion and sedimentation can be caused by construction activities or vehicular crossings, especially during periods of high stream flow or lake levels. Inadequate design or placement of structures, culverts, or bridges can alter natural sediment transport and deposition, creating scour holes or channel bars. Improper placement or sizing of gravel fill can result in erosion from pads or roadbeds adjacent to streams or lakes. Long-term effects are changes in channel morphology and composition of lake and stream bottom materials.

Improper siting of gravel-removal operations can result in changes to stream channel or lake configuration, streamflow hydraulics or lake dynamics, erosion and sedimentation, and ice damming and aufeis formation. This could result in long-term changes in stream-channel and lakeshore sand- and gravel-bar formation.

Conclusion: The cumulative effects of oil and gas exploration and development on water resources would include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst), blockages of natural channels and floodways that disrupt drainage patterns, increased erosion and sedimentation, and removal of gravel from riverine pools and lakes. These effects could cause long-term changes in stream-bank and lakeshore stability, diversions from natural drainage patterns, and variations in stream-channel and lakeshore sand- and gravel-bar formation. These effects could be reduced but not completely eliminated through application of stipulations. The cumulative effects of oil and gas exploration and development on water resources may be up to several times greater than those estimated for Alternative E.

4. Water Quality: The cumulative effects of North Slope development projects on water quality, excluding northeastern NPR-A oil development, as contained in Section IV.H.1 of the Sale 144 Final EIS (USDOI, MMS, 1996a), are herein incorporated by reference. A summary, supplemented by additional material, as cited, follows.

Spills >1,000 bbl are projected to temporarily contaminate Beaufort Sea waters several tens of square miles to levels above chronic criteria but below acute criteria. One to two such spills are anticipated (Sec IV.A.1.b). Existing causeways have caused chronic degradation of salinity, water temperature, and turbidity over a larger area in coastal nearshore lagoons. Other causal agents (gravel-island removal, permitted drilling discharges, dredging, and offshore facilities construction) would have more localized and less significant impact.

Tankering of known Beaufort Sea and non-northeastern NPR-A North Slope oil resources from the southern end of the TAPS is projected to result in 6 to 13 spills >1,000 bbl spread along the tanker route (Sec.IV.A.1.b). These spills also individually would contaminate receiving water over several tens of square miles to levels above chronic criteria but below acute criteria.

The quality of freshwater within the sale area is not affected by any of the major projects considered in cumulative case.

Contribution of the Planning Area to the Cumulative Case: With a single lease sale, the IAP is projected to add 0 to 1 spills >1,000 bbl to the 6 to 13 TAPS tanker spills projected from the existing Beaufort Sea and North Slope oil resources. These additional spills also would individually contaminate receiving water over several tens of square miles to levels above chronic criteria but below acute criteria.

For freshwaters within the planning area, analyzed cumulative effects on water quality relate primarily to proposed oil and gas leasing within the sale area. Additional factors—fecal contamination from wildlife and areas with concentrations of cabins and shelters, point-source contamination at Department of Defense sites and NPR-A historical drill sites, and oil seeps—also affect water quality but are considered part of the description of existing water quality in Sec. III.3.A.2.b.

Seismic trails could degrade long-term water quality over about 1,800 acres. Water requirements during oil exploration in the planning area could require winter extraction of the unfrozen water from hundreds of acres of nearby lakes. Temporary upslope impoundment of snowmelt waters could cover up to 200 acres. During development, because of the continued need for ice roads, annual water use would be similar to that for exploration, requiring water from up to 310-acres' worth of intermediate-depth lakes. During the seasonal construction phase during development, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake per field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 25 acres of lake for water supply for all fields. Temporary upslope impoundment of snowmelt waters by ice roads could cover up to another 90 acres. The areas affected by ice road construction would shift each year as the ice-roads are realigned and shifted to avoid continued compaction of vegetation.

Gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 1,000 acres for development. Unlike the situation for ice structures, the same locations would be affected each year over the life of the field(s).

Over the life of the field(s), spills could affect water quality of up to 18 ponds or small lakes, making their waters toxic to sensitive species for about 7 years.

For multiple sales, during peak exploration, annual ice-pad and -road construction (400-1,100-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 150 to 430 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 6 to 10 acres of lake. Temporary upslope impoundment of snowmelt waters could cover another 110 acres.

Because of the continued need for ice roads, annual water use during development for ice-road construction would be similar to that for exploration, requiring extraction of water from 150 to 230 acres of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 10 to 40 acres of lake for water supply for all fields. Temporary up-slope impoundment of snowmelt waters by ice roads could cover another 110 acres.

The primary water-quality effect from construction and placement of gravel structures during oil development is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or a 200 to 800 acres total. In flat thaw-lake plains on the

North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 1,200 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields.

Over the life of development resulting from multiple sales, spills could degrade water quality of 8 to 36 ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Multiple sales could add 0 to 2 spills >1,000 bbl to the 6 to 13 projected TAPS tanker spills.

Overall Cumulative Effects: The IAP would increase cumulative effects on marine water quality along the tanker route by 0 to 15 percent. Cumulative effects on water quality of freshwaters of the planning area would be equal to those from the proposed sale(s) alone.

Conclusion: The IAP constitutes the cumulative case for freshwater within the planning area, but only a small percent (0-15%) of the marine cumulative for water quality.

5. Air Quality: Current oil and gas development activities are required to meet the PSD criteria under the Clean Air Act. This places limits on the amount of pollutants that may be produced from existing facilities as well as those added from activity associated with the IAP. Arctic haze, which was discussed in Section III.A.3.b, is considered to be transported into the area from Europe and Asia. Current activity levels should not add to the existing haze levels. Oil development in the planning area would add an incremental amount to the emissions inventory for the North Slope, but this incremental addition would be monitored and controlled by the State of Alaska through the PSD permitting process.

Conclusion: The overall cumulative effects would be monitored and controlled through the permitting process. Effects would be negligible.

6. Vegetation: In addition to Alternative E multiple sales, presented in this document, other activities associated with the cumulative case that may affect the vegetation of Alaska's North Slope include oil development in the remainder of the NPR-A west of the planning area, Federal and State offshore oil development (through the construction of supporting infrastructure onshore), State onshore oil development, and oil transportation. All of these projects affect vegetation through the construction of infrastructure (direct effects of vegetation burial and indirect effects of vegetation change due to snow drifting, dust, etc.) and through oil spills. In terms of acres affected, construction causes more than 99 percent of the impacts, with spills having a very minor role. Most current onshore oilfield development on Alaska's North Slope is concentrated within the Arctic Coastal Plain physiographic province, which covers about 13 million acres. Most development that would result from Alternative E also would occur on the Arctic Coastal Plain and would impact vegetation on 720 to 3,800 acres. Potential development in the remainder of the NPR-A, for which there are lower resource and reserve estimates (Table IV.A.5), may impact 360 to 2,000 acres (assuming 1-5 oilfields to recover 0.1-1.2 BBbl). The current development in the Prudhoe Bay/Kuparuk areas impacts about 9,000 acres directly through gravel extraction and fill and a much larger acreage of vegetation (Walker et al., 1986, 1987), but the total impacted acreage remains a small proportion of the Arctic Coastal Plain.

No additions to the infrastructure outside the planning area for transport of NPR-A oil are expected to be required as a result of any oil development within the planning area. Therefore, all impacts to vegetation outside the planning area as a result of this plan would be from oil spills. Oil developed as a result of Alternative E would contribute 4 to 8 percent of future spills from the TAPS. Spills of oil from Alternative E that occur prior to reaching TAPS would contribute 7 to 17 percent of all onshore, non-TAPS spills on Alaska's North Slope and 6 to 15 percent of TAPS pipeline spills.

Conclusion: The impacts of Alternative E, multiple sales, on the vegetation of Alaska's North Slope, both from construction of infrastructure and from oil spills, are expected to represent a small (6-15% assuming that impacts are proportional to the amount of oil recovered) but measurable proportion of the cumulative impacts to vegetation from oil development. These cumulative impacts are expected to affect <1 percent of the vegetation of the Arctic Coastal Plain, which is the most heavily impacted of the three physiographic provinces of the North Slope.

7. Fish: This section considers other activities in addition to those associated with Alternative E that might affect arctic fish in the planning area. All are directly related to the oil and gas industry. They include additional lease sales in the northeastern NPR-A, additional lease sales in the remainder of the NPR-A, current and projected North Slope oil-development projects, former Federal and State oil and gas lease sales, and the transportation of oil and gas by pipeline. The activities associated with these projects that may affect arctic fish are the same as discussed for Alternative E (seismic surveys, construction, and oil spills). The individual effects of these activities and the agents associated with them already have been discussed (see Alternatives A-E). This analysis focuses on differences in the amount of exposure arctic fish would have to these activities/agents for the cumulative case, as compared to that of Alternative E, and estimates the resulting effect of these differences on arctic fish.

The cumulative case involves more seismic surveys and construction-related activities than Alternative E. However, many of these additional activities would be conducted outside of the planning area, and would not involve land-based seismic surveys or construction. Hence, they are not expected to have a significant effect on arctic fish within the planning area. Projects that are likely to have additional seismic and construction-related effects primarily are those associated with additional lease sales in the NPR-A. Assuming that Alternative E is implemented in the current lease sale, and assuming further that future lease sales implement similar alternatives in the proximity of similar fish habitat, their additional effect on arctic fish is likely to be proportional to the number of sales that actually occur. Based on these assumptions, if three additional sales occurred in the cumulative case, the probability of adverse effects on arctic fish would be roughly three times that of Alternative E. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of seismic and construction- related activities on arctic fish in the cumulative case. Also, if there were insufficient time for recovery between sales, the affected fish populations would be expected to experience additional adverse effects and may require a longer period of time for full recovery.

The cumulative case also involves more oil spills than Alternative E. As indicated above, many of the cumulative-case projects would be conducted outside of the planning area. The additional oil spills associated with some of these projects may adversely affect the migratory and marine fish that use the coastal areas of the NPR-A. Offshore oil spills, or those that occur in rivers and move into coastal waters are likely to increase oil-related adverse effects on arctic fish in the planning area over that of Alternative E, because oil spills associated with Alternative E are expected to be very small and would seldom enter fish habitat. Further, no oil spills associated with Alternative E are expected to make their way into the coastal environment, where the marine and migratory fish of the planning area concentrate during the summer. In contrast to this, oil spills associated with North Slope oil-development projects, former and future Federal and State oil and gas lease sales, and pipelines could spill comparatively large volumes of oil into the coastal environment. For example, Table IV.A.2-9 estimates that 7,000 to 14,000 bbl of oil could be spilled into offshore waters in the cumulative case, whereas no oil would be spilled in this area due to multiple sales in the planning area (including Alternative E).

As indicated for Alternative A, lethal effects on fish due to oil spills are seldom observed outside of the laboratory environment. For this reason, and the fact that any oil reaching the coastal area is likely to have lost most of its toxicity due to weathering, offshore oil spills are expected to have mostly sublethal effects on the marine and migratory fish affected by them. Juvenile fish (e.g., arctic cod), which are common in the nearshore area during summer, or nearshore spawners (e.g., capelin) are among those most likely to be lethally or sublethally affected. Because there is greater probability of an oil spill contacting the coastal waters of the NPR-A in the cumulative case, it is likely that cumulative case oil spills would adversely affect a greater percentage of arctic fish than estimated for Alternative E. However, assuming sufficient recovery time between spills, the estimated recovery from each spill is likely to be the same as Alternative E (3 years). Cumulative-case oil spills that do not enter coastal waters are expected to have no measurable effect on marine and migratory fish.

Conclusion: The additional effect of seismic surveys and construction-related activities over that of Alternative E is expected to be proportional to the number of future activities. Their effect on arctic fish populations may be greater if there is insufficient time for full recovery between these activities. Offshore cumulative-case oil spills are expected to have mostly sublethal effects on arctic fish populations. Those that enter coastal waters are expected to affect a greater percentage of fish than estimated for Alternative E. Assuming sufficient recovery time between spills, the recovery from each cumulative case spill is expected within 3 years. Onshore cumulative-case oil spills are expected to have an effect on arctic fish populations similar to that discussed for Alternative E.

8. Birds: The discussion of activities under the cumulative case is limited to oil and gas activities and includes both proposed and past Federal and State lease sales, and infrastructure and transportation scenarios. A detailed discussion of the numbers of Federal and State proposed and past sales as well as information on infrastructure and transportation can be found in Section IV.A.

Information regarding the potential effects to coastal birds from offshore lease sales was discussed in detail in the Beaufort Sea Planning Area Oil and Gas Lease Sale 170 DEIS (USDOI, MMS, 1997), which is incorporated by reference and summarized here. The effects of various cumulative factors, including an increased likelihood for additional oil spills, on Arctic Slope loon and waterfowl populations is likely to be substantially greater than those associated with the proposed IAP, whereas the effects on populations of other bird species is likely to remain about the same. Substantially greater molting-goose mortality is expected, if additional oil spills occur under the cumulative case. Recovery for brant and potentially other goose and loon species from substantial overall cumulative effect is expected to require more than two breeding seasons. The contribution of activities associated with proposed IAP to the cumulative effect on goose populations is expected to represent perhaps 25 percent, whereas the effect on populations of other species is expected to represent < 10 percent.

The marine component for the NPR-A sale and subsequent effects on bird populations is likely to be minor, limited to perhaps disturbance from marine vessel traffic and possibly some aircraft traffic.

Existing and projected onshore oil and gas development production activities that may affect bird populations include Prudhoe Bay, Kuparuk River, Point McIntyre, and Alpine prospect. In addition, there would be activities associated with future onshore State oil and gas lease sales. Although the potential effects of future onshore sales are speculative, additional disturbance as a result of aircraft and vehicle traffic, construction of drilling pads, pipelines, etc. as a result of new lease sales in the area would be expected. If production from Alpine prospect occurs, a pipeline will be constructed to carry oil to the existing pipelines in the Kuparuk field. The effects on birds as a result of these future activities in these areas are likely to increase only slightly. Most species are not likely to be affected by construction of the Trans-Alaska Gas System.

The overall contribution of proposed activities in the planning area to the cumulative effects on nonendangered birds is expected to be limited primarily to occasional disturbance from aircraft activities, resulting in temporary, nonlethal effects. Disturbance may last less than an hour but could continue several months in the case of summer drilling operations.

Conclusion: The overall contribution of proposed activities in the planning area to the cumulative effects on nonendangered bird populations is expected to be limited primarily to occasional disturbance from aircraft activities, resulting in temporary, nonlethal effects. Disturbance may last less than an hour but could continue several months in the case of drilling operations.

9. Mammals:

a. Terrestrial Mammals: The additive effects on caribou and on other terrestrial mammals of other ongoing and planned projects on the Arctic Slope of Alaska, as well as in the planning area, are discussed here. Although the probability of all planned and ongoing projects reaching developmental stages generally is unknown, this analysis assumes that all these plans and projects discussed in this section do reach developmental stages (Fig. IV.A.5-1). Motor-vehicle traffic along over 310 mi (about 500 km) of existing pipeline roads and an additional several hundred miles of future pipelines and roads associated with these projects could disturb, impede movements, and displace caribou and other terrestrial mammals and alter or destroy some calving and summer range through facility construction.

Oil and gas activities associated with planning area activities and other onshore and offshore projects would subject TLH, WAH, and CAH caribou and their summer and calving ranges to oil- development projects (Fig. IV.A.5-1). Potential oil spills from offshore as well as onshore oil activities associated with Federal and State of Alaska leases are likely to have a small effect on the caribou herds and other terrestrial mammals in general, because comparatively low numbers of animals are expected to be contaminated or ingest contaminated food sources and die as a result of oil spills (Sec. IV.C.9.a).

(1) Noise and Disturbance: Past seismic surveys and oil and gas exploration drilling in the planning area included approximately 4,000 mi of Federal- and 12,000 line miles of industry-conducted seismic surveys and the discovery of three noncommercial fields at Umiat, Fish Creek, and Square Lake. These activities probably briefly disturbed and displaced TLH (and, perhaps, WAH and CAH) caribou near exploration drill sites (10-12 wells) and along ice roads and aircraft transportation routes within the Teshekpuk Lake area. However, this effect would not have persisted after exploration was complete and probably had no consequential effect on the abundance or productivity of the TLH, WAH, and CAH caribou. The primary sources of disturbance of caribou and muskoxen are ground-vehicle traffic, humans on foot, and aircraft traffic near cows with newborn calves. Aircraft disturbance of caribou and other terrestrial mammals associated with cumulative oil exploration and development and resource inventory-survey activities (particularly by helicopter traffic) is expected to have short-term (few minutes to < 1 hour) effects on some caribou and muskoxen (particularly cow-calf groups), with animals being briefly displaced within about 1 mi from feeding and resting areas when aircraft pass nearby.

During development, the greatest concern from surface-vehicle road-traffic disturbance of calving caribou and interference with caribou movements is disturbance associated with roads adjacent to pipelines. Caribou are most hesitant to cross (1) under an elevated pipeline adjacent to a road and (2) when motor-vehicle traffic is present on the road. The success of crossing a pipeline-road complex in the presence of traffic depends on motivation. During the mosquito season, caribou are highly motivated to seek relief from insect harassment, and the frequency of crossing pipelines in the Prudhoe Bay-Kuparuk area increases (Curatolo, 1984) although increases in the percentage of disturbance reactions tend to reduce crossing frequency. However, caribou do successfully cross pipeline-road complexes and numerous highways in Alaska and Canada with no apparent effect on herd distribution, abundance, or integrity. Although some habituation of caribou to the road system on the oilfields is evident, cow caribou avoid areas of intensive human activity before, during, and immediately after the calving season (Smith, Cameron, and Reed, 1994). Cumulative disturbance of caribou (outside of the calving area) from road traffic (perhaps several hundred vehicles/day during construction) associated with pipelines in the cumulative case is expected to cause very short-term (a few minutes to a few hours) displacement of caribou within about 1 mi of the road. Road traffic temporarily delays the successful crossing of pipelines and roads by caribou and may have significant energetic effects on some animals but has no measurable effect on herd abundance or overall distribution. The exception to this level of effect is when disturbance levels are very high or when development facilities (especially roads) on the calving grounds cause long-term (over the life of the field) displacement—local change in distribution of cows and calves from within 1.86 to 2.48 mi (3-4 km) of roads that cross concentrated calving areas (Dau and Cameron, 1986; Cameron et al., 1992; Nellemann and Cameron, 1996).

At present, cumulative oil development in the Prudhoe Bay-Kuparuk area has caused displacement of CAH caribou from a portion of the calving range with a shift in calving distribution away from the oilfields (Lawhead et al 1997; Nellemann and Cameron, 1996). The cumulative displacement of CAH cow/calf groups from portions of the calving range with the development of additional oil fields in the Prudhoe Bay-Kuparuk area (Figs. III.B.5.a-1 and IV.A.5-1) and in the Teshekpuk Lake TLH calving area. Possible oil exploration and development within the WAH calving area could occur, if the rest of the NPR-A west of the current planning area is made available for oil and gas leasing in the future. This development could result in a long-term displacement and functional loss of habitat for TLH, WAH, and CAH caribou over the life of the oilfields.

At present, oil development has affected a portion of the calving and summer ranges of the CAH. Future State oil-lease sales in the Kuparuk Uplands, Prudhoe Bay Uplands, and North Slope Foothills will increase the amount of oil leases on the CAH range.

If full-scenario oil development (under Alternative E, with multiple lease sales, as well as the leasing of all of the NPR-A for oil exploration and possible development) were to occur, a large number of the TLH calving caribou (or most of the population) and part of the WAH caribou calving area could be exposed to development activities. Assuming calving-activity displacement (reduction in habitat use) persists beyond the construction period and lasts over the life of the oilfields, this would represent a long-term (several-generation) effect on the distribution of the TLH and WAH caribou. However, these effects may be mitigated by consolidation of facilities (especially reducing the number of roads) and by restricting surface and air traffic, humans on foot, and other activities during the calving season (Sec. IV.F.9.a).

Under NPR-A oil development in the Teshekpuk Lake area, a pipeline corridor connecting hypothetical oilfields is assumed would connect with the TAPS through the Kuparuk River oilfield and the Dalton Highway. This corridor would transect TLH and CAH movements to and from insect-relief areas along the coast of Harrison Bay east to the Kuparuk River and also would transect TLH seasonal movements east of Teshekpuk Lake. Road traffic within the oilfield-development areas would be the primary source of caribou disturbance. Surveillance-helicopter traffic along the pipeline could cause a very brief and probably inconsequential disturbance of caribou. The combined disturbance from motor-vehicle traffic and the visual presence of the pipeline (visual obstruction to the caribou's line of sight) could delay TLH movements across the oilfields in the Teshekpuk Lake area and reduce calving-activity use of habitat within 1.86 to 2.48 mi (3-4 km) of the roads (Dau and Cameron, 1986; Cameron et al., 1992; Nellemann and Cameron, 1996). Existing State of Alaska oil and gas leasing offshore and adjacent to the CAH and TLH ranges, as well as Federal OCS leases in Harrison Bay west to Smith Bay, might include offshore pipelines that come ashore within the TLH range and connect with the above hypothetical oilfields. Potential offshore oil development adjacent to the TLH and CAH ranges may increase surface-vehicle traffic disturbance of caribou along transportation corridors that would connect offshore oil discoveries with the above-discussed Teshekpuk Lake area hypothetical oilfields and TAPS (Fig. IV.A.5-1). Offshore oil development in the area probably would result in the expansion of existing coastal facilities at Camp Lonely west of Cape Halkett. Development also might increase motor-vehicle and air-traffic disturbance of caribou at insect-relief areas along the coast and perhaps reduce the seasonal use of range land near the coast by cows and calves.

The reduction in calving-habitat use within 1.86 to 2.48 mi (3-4 km) of oil-development facilities in theory, eventually could limit the growth of the Arctic caribou herds within their present ranges and may prevent the herds from reaching the maximum population size that they could achieve on their present ranges without the presence of development. Such an effect may not be apparent, because natural changes in the distribution and productivity of the herds are likely to influence the abundance and growth of caribou populations over and above the effect of reduced-habitat use caused by cumulative oil development. However, recent information on the body weights of CAH cow caribou calving on the oilfields compared with CAH cow caribou calving east of the oilfields suggests that disturbance-displacement of cow caribou may be affecting CAH caribou productivity (Cameron, 1994; Nellemann and Cameron, 1996).

(2) Habitat Alteration and Destruction: Cumulative oil development in the Prudhoe Bay-Kuparuk area encompasses over 500 mi², and hundreds of miles of gravel roads cross a large portion of the calving range of the CAH. More than 8,000 acres of habitat has been destroyed or altered where roads, gravel pads, gravel quarries, pipelines, pump stations, and other facilities are located on the Arctic Slope, and an additional 450 acres are expected to be affected by planned projects (Table IV.G-1). However, the loss of additional range habitat from facility construction in future oil development, such as in the planning area, is expected to represent a smaller portion of the available grazing habitat of the TLH (and WAH) covered by gravel pads and roads due to consolidation of facilities, such as fewer roads and gravel pads. This additional loss or alteration of habitat is expected to represent a minor effect on caribou. However, displacement of calving caribou due to disturbance has resulted in a significant functional loss of habitat on the existing oilfields. A comparable functional loss of calving habitat might occur in the Teshekpuk Lake area and might occur within the calving range of the WAH, if all of the NPR-A were available for oil and gas leasing.

(3) Effects of Increased Access from Roads and Other Facilities: The development of more transportation corridors in support of oil development on the North Slope, particularly roads that eventually may be open to the public, would increase human access to the Arctic Slope caribou herds and other terrestrial mammals, which could result in increased hunting pressure and perhaps overharvest of some populations. Hunting caribou with firearms south of the oilfields along the Dalton Highway is not permitted within 5 mi of the highway; however, hunting by bow and arrow is permitted within that distance. Noise and disturbance associated with hunting of caribou and other terrestrial mammals is not expected to have any significant effect on the movements of these mammals across the Dalton Highway and other North Slope roads. Caribou have continued to cross roads and highways, even when subjected to heavy hunting pressure and to the increased noise and disturbance associated with hunting (Valkenburg and Davis, 1986).

The increase in the number of development facilities on the Arctic Slope is expected to increase the number of adverse interactions between humans and grizzly bears, resulting in the loss of bears due to their attraction to human refuse. These interactions are expected eventually to result in a decline in grizzly bear abundance near development areas. Cumulative oil development on the Arctic Slope also is expected to result in an increase in abundance of arctic foxes near development areas, which adversely may affect tundra-nesting birds and may pose a health hazard to humans through the spread of rabies among the growing fox population.

(4) Effects of Global Warming: An increase in abundance of deciduous shrubs, especially birch (less favorable caribou forage), and a decline in the abundance of grasses-sedges such as *Eriophorum vaginatum* (an especially important food of calving caribou) are predicted to occur if a significant increase in temperatures occurs in the Arctic thereby reducing productivity of caribou habitats on the Arctic Slope (Anderson and Weller, 1996). Over decades, warming temperatures could result in the invasion of tundra habitat by taiga woody plants (taiga forests), a less favorable habitat for tundra mammals and birds, thereby adversely affecting their populations (Anderson and Weller, 1996).

(5) Overall Cumulative Effects: Combined onshore and offshore oil and gas development and resource inventory-survey activities in the planning area and ongoing activities on the Arctic Slope are likely to have some long-term, effects on the distribution of CAH, TLH, and WAH caribou on at least parts of their calving areas and adversely affect other terrestrial mammals.

Cumulative reduction in habitat use near facility-construction projects (such as gravel mining, roads, pipelines, and drill pads) and caribou avoidance (cows with calves) of habitat areas with road traffic could have a long-term effect on the distribution of CAH, TLH, and WAH caribou by displacing some portion of these caribou herds from a part of their calving and summer ranges over the life of the oilfields. This functional reduction in habitat may lead to a reduction in caribou abundance. Such an effect is not conclusive, because present levels of onshore oil development in the Prudhoe Bay area have not demonstratively affected the overall abundance of the CAH. However, recent information on body weights of CAH cow caribou that calve on the oilfields compared to CAH cow caribou that calve east of the oilfields suggests that disturbance-displacement of cow caribou may be affecting caribou productivity (Cameron, 1994; Nellemann and Cameron, 1996). The construction of roads in support of oil development would increase human access to the Arctic caribou herds and other terrestrial mammals. The resultant increased hunting pressure on these populations could lead to overharvest. However, existing hunting regulations (with modifications if necessary) are expected to prevent excessive overharvesting of any of these populations on the Arctic Slope. The increase in the number of development facilities on the Arctic Slope is expected to increase the number of adverse interactions between humans and grizzly bears, resulting in the loss of bears due to their attraction to human refuse. These interactions are expected eventually to result in a decline in grizzly bear abundance near development areas. Cumulative oil development on the Arctic Slope also is expected to result in an increase in abundance of arctic foxes near development areas, which may adversely affect tundra-nesting birds and may pose a health hazard to humans through the spread of rabies among the growing fox population.

If global warming occurs and reduces the abundance and distribution of tundra grasses, caribou and other terrestrial mammals may be adversely affected.

Conclusion: Cumulative effects on caribou calving distribution are likely to be long term over the life of the oilfields, but probably local within 1.86 to 2.48 mi (3-4 km) of roads located within calving areas. This reduction in calving and summer habitat use by cows and calves of the CAH and TLH and possibly on WAH caribou from future NPR-A leasing, represents a functional loss of habitat that may result in a long-term effect on caribou herd productivity and abundance. However, this potential effect may not be measurable due to the great natural variability in caribou population productivity. The contribution of the planning-area oil exploration and development activities to the cumulative effects on the TLH (and on WAH caribou from NPR-A- wide possible oil exploration and development activities) is estimated to be perhaps 80 to 90 percent and on the CAH, perhaps 10 percent. If global warming occurs during the next several decades with widespread changes in vegetation associated with warming temperatures, much longer term effects on Arctic terrestrial mammals may occur. Cumulative oil development on the Arctic Slope also is likely to result in an increase in abundance of arctic foxes near development areas, which may present a rabies health hazard to humans in the oilfield areas; and the attraction of grizzly bears to human refuse is expected to lead to the loss of bears due to interactions with humans and an eventual decline in bear abundance near development areas. The cumulative effects on muskoxen, moose, wolves, and wolverines (other than global warming) are likely to be local within about 1 to 2 mi of oil exploration and development facilities and resource inventory-survey activities and generally short term, with no significant adverse effects on their populations.

b. Marine Mammals: Discussed in this section are the additive effects of ongoing and future development on marine mammals in the Alaskan Arctic, in winter ranges in the Bering Sea, and along oil-tanker routes in the Gulf of Alaska. Development could have actual or potential adverse effects on the distribution or abundance of ice seals (ringed, spotted, and bearded seals), walruses, belukha whales, and polar bears in the Alaskan Arctic (and subarctic-Bering Sea), and harbor seals and sea otters in the Gulf of Alaska. Oil and gas development could affect these species as a result of oil spills, noise and disturbance, and habitat alteration. Other activities with potential effects are commercial fishing and hunting/harvesting.

(1) Effects of Spills:

(a) Arctic Region Planning Areas: Cumulative oil-spill risks to marine-mammal habitats from Camden Bay west to Point Barrow could develop from activities associated with: Federal OCS Sale 170; offshore development at Endicott, North Star, and Liberty; onshore development on the NPR-A and at Sourdough, Alpine, and Badami; and possible barging of fuel oil for oil exploration and development in the planning area.

An important habitat for marine mammals is the active-ice, or ice-flaw, zone. Seals, walruses, and belukha whales would be most vulnerable to spills contacting this zone; polar bears would be most vulnerable to spills contacting the flaw zone or the coast.

Offshore spills obviously pose a higher risk to marine mammals than onshore spills, but along the coast of the planning area some aggregations of seals and walruses and a small number of polar bears could be contaminated by onshore spills that reach marine waters and could suffer lethal or sublethal effects.

Spills that occurred during the open-water season (summer), or that occurred during the winter and persisted in the Beaufort Sea area after melt-out, pose the highest risk to marine-mammal habitats. However, spills could also have effects in winter. A small number of breeding ringed seals and their pups are likely to be contaminated by spills that occur during the winter, resulting in the death of a relatively small number of pups because of the sparse distribution of pupping lairs. During the winter season, nonbreeding ringed seals, bearded seals, and polar bears could be exposed to cumulative oil spills that contact the ice-flaw-zone habitat and the Northern Lead System off Point Barrow. During the summer, or open-water season, marine mammals in the western Beaufort Sea could be exposed to spills that occur to the east during the winter and contact the flaw-zone habitat.

The most noticeable effects of potential oil spills from offshore oil activities would be through contamination of seals, walruses, and polar bears, with lesser effects on belukha whales. Losses from an estimated 1 to 2 oil spills >1,000 bbl (Table IV.A.2-8) could be <1,000 seal pups ands adults, <1,000 walrus calves and adults, and <30 polar bears out of a population of 1,300 to 2,500 bears. (Assuming the current growth rate of 2.4% probably would replace lost bears within <1 generation [or 3-5 years] given the potential biological removal rate of 48 bears/year and assuming equal sex ratio of removed bears and a subsistence harvest of 20-30 bears/year [USDOI, FWS, 1995]). These losses are likely to be replaced within one generation or less (about 5-7 years) with a generation time of about 5 years for ringed seals and at least 7 years for polar bears (Kelly, 1988; USDOI, FWS, 1995). Belukha whales are likely to suffer low mortality (< 10 whales), with population recovery expected within 1 year.

(b) Arctic Oil Transportation Through Prince William Sound and Gulf of Alaska: Potential future oil-spill effects from tanker transportation of Arctic oil (including NPR-A oil) from the TAP terminal at Valdez could have serious cumulative effects on marine mammals, especially sea otters, in Prince William Sound and the Gulf of Alaska. There also could be local effects on the survival of young harbor seals if the spill occurred during the pupping season, as did the 1989 *Exxon Valdez* spill (11 million gal or 258,000 bbl of crude oil). Indications from scientific studies of the effects of the spill suggest that the local sea otter populations in Prince William Sound, Kenai Peninsula, and the Kodiak-Katmai Bay area were substantially reduced. The western Prince William Sound sea otter population may have been reduced by at least 2,650 otters out of an estimated 6,500 otters (Garrott, Eberhardt, and Burn, 1993). The Kenai Peninsula and Kodiak-Katmai Bay sea otter populations probably suffered smaller losses (a few hundred otters) due to weathering and dispersion of the spill. It is likely that local assemblages or populations of sea otters in heavily contaminated coastal areas of Prince William Sound will take more than one to two generations, or >5 years, to recover from the spill. The oil spill also adversely affected the survival of harbor seal pups at pupping areas contaminated by oil and was estimated to have killed about 300 harbor seals (Frost et al., 1994). Oil resources estimated for Alternative F represent 4 percent of total North Slope onshore and offshore oil resources. By 2009, projected NPR-A production (under Alternative F multiple sales) could constitute 8 to 14 percent of the oil transported through the TAPS (at $18 bbl) and in tankers through Prince William Sound. Assuming tanker spills occur, cumulative transportation of North Slope oil through Prince William Sound is expected to have a long-term (≥ 5 years) effect on seas otters and harbor seals.

(2) Effects of Noise and Disturbance: In the Beaufort Sea and Alaska Arctic Slope, cumulative noise and disturbance effects on breeding ringed seals from on-ice seismic surveys and possible from overland hauls that sometimes occur on stable sea ice adjacent to the NPR-A planning area are expected to have a short-term (≤1 year) effect on ringed seals, because only a small percentage of the population (perhaps 1-3%) is likely to be disturbed; and even fewer pups are likely to be lost due to adult abandonment of maternity lairs (USDOI, MMS, 1997). Cumulative noise and disturbance of belukha whales during spring migration from icebreaker and vessel traffic could have a local effect on the movement of some whales if their migration was delayed or diverted due to frequent traffic in the ice-lead system. Other cumulative noise and disturbance effects from many helicopter and vessel trips per month are expected to be short term (a few minutes to < 1 hour) because the disturbance reactions of seals, polar bears, and belukha whales would be brief — with the affected animals returning to normal behavior patterns and distribution within a short period of time after the boat or aircraft has left the area — and no long-term effects are expected to occur. These disturbance reactions are not likely to be additive. Cumulative disturbance effects on polar bears are expected if some coastal denning areas in the Beaufort Sea or along the Arctic coast are disturbed and some maternity dens on the sea ice or on the coast were abandoned because of noise and human presence near denning areas. However, existing requirements under the MMPA are expected to prevent excessive disturbance of the bears.

Some polar bears could be killed as a result of human-bear encounters near oil camps and other facilities associated with cumulative oil development. In the Northwest Territories, from 1976 to 1986, 15 percent (33 of 265) of polar bears killed as a result of conflicts with humans occurred near industrial sites (Stenhouse, Lee, and Poole, 1988). Some of these losses are unavoidable and represent a small source of mortality on the polar bear population that would be replaced by recruitment within 1 year. Four bears were unavoidably killed after being attracted to offshore platforms in the Canadian Beaufort Sea over a 5-year period of intensive oil exploration (Stirling, 1988). The incidental loss of polar bears due to cumulative oil and gas development in the Arctic is unlikely to significantly increase the mortality rate of the polar bear population due to subsistence harvest and natural causes.

Migratory populations of belukha whales, walruses, and spotted, ringed, and bearded seals have been exposed to oil-exploration activities (seismic surveying, drilling, air and vessel traffic, dredging, and gravel-dumping operations) in the Beaufort Sea and exposed to some industrial activities in the Bering and Chukchi seas. The exposure of the marine-mammal populations to the above activities and to other marine-vessel traffic (oilfield sealift-barge traffic to the Arctic Slope and increased icebreaker activity in support of offshore oil exploration) may increase in the future. These industrial activities are likely to have some short-term (<1 generation) effects on the distribution of migratory seals, walruses, and belukha whales during the seasonal drilling season. If and when oil development occurs, some local changes (within a few miles of the activity) in the distribution of their populations could occur. However, some habituation of seals, walruses, and belukha whales to noise and human presence is likely to occur. The displacement associated with cumulative industrial activities or coincidental to such activities is not expected to result in a significant reduction in the overall abundance, productivity, or distribution of these marine mammals adjacent to the planning area and in the Beaufort Sea.

Helicopter trips flying along the coast to and from Camp Lonely, Prudhoe Bay, and NPR-A exploration and production facilities in the planning area could disturb some polar bears and seals hauled out near the coast. However, disturbance of some hauled-out seals during the spring pupping season could cause them to panic and charge into the water, resulting perhaps in the injury, death, or abandonment of small numbers of seal pups. This potential disturbance of seals and polar bears is expected to cause short-term displacement of individual animals (a few minutes to less than a few days) within about 1 mi of the air traffic route and to have no significant effects on their populations near the planning area.

(3) Effects of Habitat Alteration: About 40 exploration-drilling units have been installed or constructed in the Beaufort Sea as a result of past Federal, State, and Canadian oil and gas leases. Several million cubic yards of gravel and dredge-fill material have altered a few square miles of benthic habitat in the Beaufort Sea. The cumulative effects of habitat alterations associated with platform construction, dredging, pipeline burial, and causeways are expected to have local (within about 1 mi) effects on some benthic food organisms and some fish species and are likely to have a short-term (<1 year or season) and local (1-2 mi) effect on the availability of these marine-mammal food sources.

Exploration-drilling units and future production platforms in the Beaufort Sea are expected to have some local effects on ice movements and fast-ice formation. These local changes are likely to have a short-term (<1 year) effect on seal distribution during platform installation and construction activities. However, natural variation in ice conditions and resulting changes in seal, polar bear, and belukha whale distribution are likely to reverse or overcome any local reduction in the distribution of these species.

(4) Effects of Other Activities.

(a) Effects from Commercial Fishing: In the Bering Sea, the actual and potential effects of commercial fishing on harbor seals, ice seals, walruses, and belukha whales include the following: (1) direct mortality from entanglement in fishing gear and from shooting of marine mammals raiding fishing nets; (2) competition for prey/commercial-fish species that could reduce the availability of prey for marine mammals; and (3) displacement of marine mammals due to noise and disturbance from boats and aircraft associated with intense fishing activities. In Bristol Bay, the entanglement of belukha whales in the salmon gillnet fishery is an additive source of mortality for some pods of belukhas. In the Bering Sea, migratory spotted seals are likely to experience some mortality through entanglement in nets used by herring fishing operations along the coast. In the southern Bering Sea and Gulf of Alaska, entanglement of migratory fur seals in discarded fishing gear, as well as incidental catches of sea lions in bottom-fishing trawl operations, are likely to have been contributing factors in the decline of these populations.

Competition for fish (particularly pollock and perhaps pandalid shrimp in the western Gulf of Alaska) is known to occur between marine mammals and commercial fishing. The rapid increase in the bottom fishery in the Gulf of Alaska and in the southern Bering Sea and/or the crash in the shrimp and capelin populations in the western Gulf of Alaska might be contributing causes for the >80-percent decline of northern sea lions and harbor seals over the past 20-30 years (Loughlin, 1989; Hansen, 1996).

At present, migratory ice seals (spotted, ringed, and bearded seals) and belukha whales that summer in the Arctic and winter in the Bering Sea are believed to have experienced only low losses in numbers due to direct mortality or food competition from commercial fishing in the northern Bering Sea, where the fleet is small (hundreds of boats) compared to the fleet in the southern Bering Sea-Bristol Bay and Gulf of Alaska (thousands of boats). These arctic marine-mammal populations are not exposed to such intense fishing activities during the winter months when they migrate to the northern Bering Sea. However, the amount of commercial-fishing activity has increased greatly in the northern Bering Sea, and migratory marine mammals are exposed to an increasing number of vessels. It is likely that temporary displacement (minutes to hours to 2-3 days) of seals, walruses, and belukha whales occurs as a result of vessel and air traffic associated with commercial fishing in Bristol Bay and Norton Sound.

Longer displacement (several days to a few months) of some portions of migratory marine-mammal populations probably is occurring in areas of intense commercial-fishing activity. Up to 33 percent of the walrus herd that seasonally hauls out on Round Island in Bristol Bay apparently has been displaced from the area as a result of the bottom-trawl-fishing operations occurring near the island in the summer (Lowry, 1989, pers. comm.). This seasonal displacement of about 6,000 walruses to other haulout sites is not likely to have had a significant adverse effect on the productivity and abundance of the walrus population, but could represent a long-term (several-year), seasonal effect on the distribution of a portion of the population if this reduction in habitat use persisted for several years.

To summarize, the overall effects of commercial fishing on seals, walruses, and belukha whales include direct mortality from entanglement in fishing gear and shooting, competition for prey commercial-fish species, and disturbance displacement from vessel traffic. In the Bering Sea and in the Arctic, some populations of spotted seals and walrus could experience long-term (several-generation) displacement due to increase traffic and competition for prey species. Seals and belukha whales could experience an increase in direct mortality as a result of net entanglements and shootings. They could also experience a long-term (several-generation) decline in productivity and abundance as a result of increased competition for prey species. The intense commercial bottom-trawl fishery for pollock and other bottomfish may have had a long-term effect on regional northern sea lion and harbor seal populations in the southern Bering Sea and in the Gulf of Alaska.

(b) Effects from Hunting/Harvesting on the Pacific Walrus Population: The annual harvest of Pacific walruses more than doubled from the 1970's (3,000-4,000 animals) to the 1980's (6,000 to ~10,000 animals), with a total combined catch by Soviet and American hunters at 10,000 to 15,000 per year, or 4 to 6 percent of the population (Fay, Kelly, and Sease, 1989). During this same time, herd productivity and calf survival declined sharply. Because the population had reached the carrying capacity of the environment, the increased harvest occurred at the same time that the population was experiencing a natural decline in productivity (Fay, Kelly, and Sease, 1989).

Harvest exploitation rates of ~10,000 walruses per year caused the population to decline by about 50 percent according to Fay, Kelly, and Sease (1989), representing a long-term (several-year) effect on the walrus population. A cooperative reduction in harvest rates by Soviet and American hunters would prevent such a population decline. However, some decline might continue into the next decade before any reversal or recovery of the population would begin (Fay, Kelly, and Sease, 1989). Optimistically, the international hunting of Pacific walruses still would have a short-term (<1 generation) effect on the walrus population. International subsistence hunting of other pinnipeds and belukha whales is believed to have no more than a short-term effect on migratory seals and belukha whales.

Conclusion: Cumulative effects are generally expected to be relatively short term (within <1 generation) on ice seals (ringed, bearded, and spotted seals), walruses, polar bears, and belukha whales and longer term (>1 generation to perhaps several generations) on sea otters and harbor seals. Under Alternative E (with multiple sales and possible NPR-A-wide oil and gas exploration and development), oil resources are estimated to represent 8 percent of the total North Slope production, and production by 2009 could make up 8 to 14 percent (at $18/bbl) of oil carried in tankers in Prince William Sound. As a result, planning-area activities are projected to contribute about 8 percent of the risk of oil-spill mortality and other effects on ice seals, polar bears, walruses, and belukha whales, and 8 to 14 percent of the risk of mortality to sea otters and harbor seals.

10. Endangered and Threatened Species: The discussion of activities under the cumulative case is limited to oil and gas activities and includes both proposed and past Federal and State lease sales and infrastructure and transportation scenarios. A detailed discussion of the numbers of past and proposed Federal and State sales as well as information on infrastructure and transportation can be found in Section IV.A.5. The BLM makes an assumption that all of the NPR-A west of the current planning area would be made available for oil and gas leasing within 10 years of completion of the current planning effort. Preliminary resource estimates for the NPR-A west of the planning area range from 130 to 1,240 MMbbl. It also is assumed that stipulations similar to those that apply to Alternative E would also be incorporated in future decisions to make additional NPR-A lands available for leasing. The BLM assumes that the resulting oilfield infrastructure and associated surface disturbance would be similar to that forecast for the planning area under Alternative E. Should the area west of the current planning area be made available for oil and gas leasing, appropriate NEPA actions and endangered species consultations would be conducted.

For the cumulative case it is estimated there is a 32- to 62-percent chance of one or more spills ≥1 gal occurring as a result of Federal offshore sales in the Beaufort Sea with the most likely number of spills being 0 and a 71- to 88-percent chance of one or more spills ≥1 gal occurring as a result of State offshore sales in the Beaufort Sea with the most likely number of spills being 1 to 2 over the assumed production life of the planning area (Table IV.A.2-8). It is estimated that from 1,254 to 2,149 spills ≥1 gal could occur from State onshore leases and that from 100 to 438 spills ≥1 gal could occur from NPR-A activities within the planning area (Table IV.A.2-8). It is estimated that from 26 to 239 spills ≥1 gal could occur from NPR-A activities west of the planning area (Table IV.A.2-8). Information pertaining to oil spills can be found in Section IV.A.2.

a. Effects on the Bowhead Whale: Information regarding the potential effects on bowhead whales from offshore lease sales was discussed in detail in the Beaufort Sea Sale 170 DEIS (USDOI, MMS, 1997), which is incorporated by reference and summarized here. Under the cumulative case, there could be an increase in seismic surveys, aircraft and vessel traffic, drilling, and construction activity as a result of existing leases and future sales, although bowhead whales generally are less likely to encounter activities in State waters. Bowheads may exhibit avoidance behavior if closely approached by vessels or seismic-survey activity but are not affected much by any overflights, unless aircraft altitudes are below 328 yards. Whales would also likely try to avoid being closely approached by motorized hunting boats. Bowheads have been sighted near drillships, although some bowheads probably change their migration speed and swimming direction to avoid close approach to them. Whales appear to exhibit less avoidance behavior with stationary sources of relatively constant noise than with moving sound sources. Bowheads do not seem to travel more than a few kilometers in response to a single disturbance incident; and behavioral changes are temporary, lasting from minutes (in the case of vessels and aircraft) up to 30 to 60 minutes (in the case of seismic activity). Overall, exposure of bowhead whales to noise-producing activities from oil and gas exploration and development and production operations is not expected to result in lethal effects; but some individuals could experience temporary, nonlethal effects. Because more oil spills are assumed to occur under the cumulative case than over the life of the proposed action, the probability is greater that whales may be contacted by spilled oil; and oil-spill effects are likely to be greater. However, the probability of oil actually contacting whales would be considerably less than the probability of contact with bowhead habitat. Some individuals may be killed or injured as a result of prolonged exposure to freshly spilled oil; however, the number of individuals so affected is expected to be small. Overall, prolonged exposure of bowhead whales to spilled oil may result in lethal effects on a few individuals, with the population recovering within 1 to 3 years. Most individuals exposed to spilled oil are expected to experience temporary, nonlethal effects. Bowhead whales are not likely to be affected by the construction of the TAPS or tankering of crude oil from Valdez.

The overall contribution of proposed activities in the planning area to the cumulative effects on bowhead whales is expected to be limited to temporary avoidance behavior in response to vessel and aircraft activities.

b. Effects on the Spectacled and Steller's Eiders: Information regarding the potential effects on spectacled and Steller's eiders from offshore lease sales was discussed in detail in the Beaufort Sea Sale 170 DEIS (USDOI, MMS, 1997), which is incorporated by reference and summarized here. Spectacled and Steller's eiders in marine waters of the Beaufort Sea are not expected to experience significant adverse effects from drilling discharges or noise-producing activities associated with offshore exploration and development/production. Disturbance of some individuals as a result of offshore operations is expected to be unavoidable over the long term. Some mortality could result from contact with spilled oil. The effects of various cumulative factors, including an increased likelihood for additional oil spills, on the Arctic Slope spectacled eider population is likely to be substantially greater than those associated with any the proposed Sale 170 action, whereas the effects on the Arctic Slope Steller's eider population is likely to remain about the same. Substantially greater spectacled eider mortality is expected if additional oil spills occur under the cumulative case. Recovery for either species from substantial overall cumulative effect is not expected to occur, if the population decline of recent decades persists.

Both spectacled and Steller's eiders may be affected by activities proposed for the NPR-A sale, as discussed under Alternatives A through E. The marine component for the NPR-A sale and subsequent effects on eiders is likely to be minor, limited to perhaps disturbance from marine- vessel traffic and possibly some aircraft traffic.

Existing and projected onshore oil and gas development production activities that may affect eiders include Prudhoe Bay, Kuparuk River, Point McIntyre, and the Alpine prospect. In addition, there would be activities associated with future onshore State oil and gas lease sales that may affect eiders, although the potential effects of the future onshore sales on eiders is not clear. There likely would be additional disturbance as a result of aircraft and vehicle traffic, construction of drilling pads, pipeline, etc. as a result of new lease sales in the area. If production from the Alpine prospect occurs, a pipeline will be constructed to carry oil to the existing pipelines in the Kuparuk field. The effects on eiders as a result of these future activities in these areas are likely to increase only slightly. Few Steller's eiders are found east of the Colville River, and the majority of spectacled eiders are found west of the Colville River, although they are present throughout the Prudhoe Bay and Kuparuk fields. Eiders are not likely to be affected by construction of the TAPS or tankering of crude oil from Valdez. Tankering of oil produced in the planning area under Alternative E represents from 4 to 7 percent of all oil transported by tanker from Valdez.

As stated above, BLM makes an assumption that all of NPR-A west of the current planning area would be made available for oil and gas leasing within ten years of completion of the current planning effort. It is assumed that stipulations similar to those that apply to Alternative E would also be incorporated in future decisions to make additional NPR-A lands available for leasing. No information is available with respect to resource estimates or levels of oil and gas activities expected in the area. Also, no information is available regarding the levels of activities other than oil and gas activities. In general, densities of both spectacled and Steller's eiders are higher in the area west of the current planning area. It is likely that disturbance to eiders as a result of both oil and gas activities and other activities would be greater in the area west of the planning area than in the planning area itself.

Overall, the effects of spectacled and Steller's eiders as a result of various cumulative factors is likely to be substantially greater than for any single activity or any activities associated with any individual lease sale. Disturbance of some individuals as a result of both onshore and offshore oil and gas operations is expected to be unavoidable over the long term. Some mortality could result as a result of contact with spilled oil. Improper containment or disposal of refuse at onshore support camps could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adult eiders. The overall contribution of proposed activities in the planning area to the cumulative effects on spectacled and Steller's eiders is expected to be limited primarily to occasional disturbance from aircraft activities resulting in temporary, nonlethal effects. Disturbance may last less than an hour but could continue all summer in the case of summer drilling operations. The overall contribution to the cumulative effects on species along transportation routes from tankering oil produced in the planning area to ports along the U.S. West Coast is expected to be minimal.

c. Effects on Species along the Transportation Routes: Analysis of the oil-spill risk on species along transportation routes in the Gulf of Alaska/U.S. West Coast, particularly the southern sea otter and marbled murrelet, can be found in the Cook Inlet Sale 149 FEIS (USDOI, MMS, Alaska OCS Region, 1996b), which is incorporated here by reference and summarized in Alternative A. Analysis of the potential effects of an oil spill on species along transportation routes to ports in the Far East can be found in the Beaufort Sea Sale 144 FEIS (USDOI, MMS, 1996a), which also is incorporated by reference and summarized in Alternative A. It is anticipated that most oil produced as a result of an NPR-A sale would be shipped to southern ports rather than to Far East ports.

Conclusion: Exposure of bowhead whales to noise-producing activities from both onshore and offshore oil and gas exploration and development and production operations is not expected to result in lethal effects; but some individuals could experience temporary, nonlethal effects. Prolonged exposure of bowhead whales to spilled oil may result in lethal effects on a few individuals, with the population recovering within 1 to 3 years. Most individuals exposed to spilled oil are expected to experience temporary, nonlethal effects. The overall contribution of proposed activities in the planning area to the cumulative effects on bowhead whales is expected to be limited to temporary avoidance behavior in response to vessel and aircraft activities.

Overall, the effects on spectacled and Steller's eiders as a result of various cumulative factors from both onshore and offshore oil and gas exploration and development and production operations is likely to be substantially greater than for any single activity or any activities associated with any individual lease sale. Disturbance of some individuals as a result of both onshore and offshore oil and gas operations is expected to be unavoidable over the long term. Some mortality could result from contact with spilled oil. Cumulative effects are likely to be greater on the Arctic Slope spectacled eider population than on the Arctic Slope Steller's eider population. The overall contribution of proposed activities in the planning area to the cumulative effects on spectacled and Steller's eiders is expected to be limited primarily to occasional disturbance from aircraft activities resulting in temporary, nonlethal effects. Disturbance may last less than an hour but could continue all summer in the case of summer drilling operations. Improper containment or disposal of refuse at support camps could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adult eiders.

The overall contribution to the cumulative effects on species along transportation routes from tankering oil produced in the planning area to ports along the U.S. West Coast is expected to be minimal.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: For the cumulative case, there would be no economic effect.

b. Oil and Gas Exploration and Development Activities: Increased revenues and employment would be the most significant economic effects generated by the cumulative case. Effects on the economy in the cumulative case are assessed in terms of (1) current conditions, described in Section III.C.1; (2) effects from Alternative E, described in Section IV.F.11; (3) and effects from the projects of the cumulative case, described in Section IV.A.2. These activities taken together are assumed to result in economic effects that are two times the effects of Alternative E. Analysis of effects on the economy takes into account that effects from increased revenues and employment would be the most significant economic effects generated by the existing and proposed projects in the cumulative case. Increased tax revenues and new employment would be created with the construction, operation, and servicing of facilities associated with IAP activities.

(1) North Slope Borough Revenues and Expenditures: Potential revenues will be determined by several different factors; therefore, the revenue projections should be considered with the understanding that many uncertainties exist. Exploration, development, and production are projected to generate increases in property taxes above the levels without the cumulative case starting in 2000, averaging about 6 to 12 percent each year through the production period, or about $12 to $24 million. The increase would decline over the period of oil and gas activity due to depreciation of the infrastructure. In general, the property-tax increases associated with the cumulative case would be two times those associated with Alternative E.

(2) NSB Employment: The gains from the cumulative case in direct employment would include jobs in petroleum exploration, development, and production and jobs in related activities. Gains would be two times those for Alternative E (Table IV.F.11-1). For the cumulative case, direct employment is anticipated to peak in the range of 4,400 to 8,400 jobs during the development phase, and decline to a level in the range of 1,400 to 2,800 during production from 2018 to 2028. All of these jobs would be filled by commuters who would be present at the existing enclave-support facilities in and near the Prudhoe Bay complex approximately half of the days in any year. Most workers would commute to permanent residences in the following three regions of Alaska: Southcentral, Fairbanks, and to a much smaller extent, the North Slope. Some workers would commute from the enclaves to permanent residences outside Alaska, especially during the exploration phase.

Because of the development of facilities or the continued use of facilities that are taxable by the NSB, the NSB would have additional revenues that most likely would be used for ongoing operations. This in turn results in NSB-government jobs.

For the cumulative case, increases in total NSB-resident employment would be two times those of Alternative E, or in the range of 128 to 236 jobs during the peak of development, leveling off to 46 to 120 during production after 2017 (Table IV.F.11-1). The peak increase in resident employment is about 8- to 16-percent greater with the cumulative case than without during development, and about 4- to 10-percent greater during production. The increase in employment opportunities partially may offset declines in other job opportunities and delay expected outmigration. Increases in resident population also would be two times those of Alternative E and would correspond to increases in employment.

It is assumed that NSB-resident Natives would hold approximately 1 percent of the oil-industry jobs, based on historical experience. No workers would be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

(3) Effects of Subsistence Disruptions on the NSB Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents primarily through the direct loss of subsistence resources. See Section IV.G.13 for effects on subsistence-harvest patterns.

(4) State Revenues: State revenues would increase as a result of the cumulative case, the increases being about twice those of Alternative E. For the cumulative case, property-tax revenues to the State would be approximately 25 percent of the revenues to the NSB, or $3 to $6 million annually. State royalty income would be in proportion to production, or approximately $0.25 million for each 1 MMbbl of oil produced and flowing through the TAPS, or $5 to $20 million annually. State severance tax would be half that amount, or $2.5 to $10 million annually. For these ratios and a more detailed explanation for the above analysis, please see *Alaska Statewide and Regional Economic and Demographic Systems: Effects of OCS Exploration and Development, 1990* (UAA, ISER, 1990).

(5) Southcentral Employment: Workers in the enclave centered at Prudhoe Bay probably would commute to permanent residences in Southcentral Alaska, Fairbanks, and outside the State. However, for the purpose of this analysis, it is assumed all of the enclave workers commute to Southcentral Alaska and have permanent residences there except during peak construction years. For the cumulative case, the number of workers would be two times that Alternative E (Table IV.F.11-1). Every enclave worker generates approximately five additional jobs, and these are assumed to be located in Southcentral mostly in the trade, finance, and service sectors. This is a result of spending by enclave workers, who have higher than average wages, which has a multiplier effect on the economy and generates additional employment.

For the cumulative case, during production, the population in Southcentral Alaska generated directly and indirectly by enclave workers would be twice that generated under Alternative E, and would be in the range of 21,000 to 42,000, or 5.6 to 11.4 percent of the Southcentral population. In the 7-year period of the exploration and development phases, the population directly and indirectly associated with the cumulative case would rise to the level sustained during production (or methodology, see Alternative E).

Conclusion: Activity other than oil and gas would have no effect on the economy. The cumulative case is projected to generate increases two times those of Alternative E. The effects of the cumulative case above the levels of Alternative E are as follows. NSB property taxes, 3 to 6 percent ($6 to $12 million); direct oil-industry employment, 700 to 1,400 (five times this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 2 to 5 percent; and annual revenues to the State of $1.5 to $3 million, $2.5 to $10 million, and $1.5 to $5 from property tax, royalty income, and severance tax, respectively.

12. Cultural Resources: In general, cumulative impacts to cultural resources would result from development and production activities rather than exploration activities. However, cultural resources are not ubiquitous as is the case with wildlife, habitat, or scenic value, and it is possible that cultural resources might not be impacted by petroleum-related activities. If they occur, it is probable that significant cumulative impacts would be greatest in areas of high oil and gas potential.

Conclusion: Overall, cumulative impacts would be similar in nature and intensity to those described in Alternative E.

13. Subsistence-Harvest Patterns: Cumulative effects on subsistence-harvest patterns include effects of multiple lease sales in the NE NPR-A Planning Area and other ongoing or planned projects on the North Slope that would include Federal and State offshore lease sales and State and private activities expected to occur in the future. Nearby developments include future State of Alaska oil and gas lease sales (9 areawide sales including both on- and offshore tracts over the next 5 years), offshore development of the Northstar project, potential development in the Kuvlum and Hammerhead units and at the Liberty prospect (Tern Island), development of the Alpine oil and gas field in the Colville River Delta area, OCS Oil and Gas Lease Sale 144, and future OCS Oil and Gas Lease Sales 170 and 176 in the Beaufort Sea in the years 1998 and 2000, respectively. Additionally, LNG tankering from a potential facility near Valdez for TAGS natural gas and potential crude-oil tankering to the Far East from the port of Valdez are considered. The probability of any or all of the ongoing and planned offshore and onshore projects reaching the development and production stage is unknown; however, the following discussion assumes that all of these projects would reach the development and production stage. As for the proposed action, the effects of these projects on subsistence would occur from oil spills; noise from seismic activities; air- and road-traffic disturbance; disturbance from construction activities associated with pipelines; oil facilities (construction, installation, and operation); roads and landfalls; supply efforts; and from the tankering of oil.

The probability of the North Slope experiencing the effects of one or more oil spills is substantially higher in the cumulative case than it is for Alternative E, the maximum-resource alternative. In the cumulative case, oil-spill-occurrence estimates indicate a total of 1 to 2 spills >1,000 bbl from offshore pipelines and platforms from Federal and State activity, with an estimated 71- to 88-percent chance of occurring in the Alaskan Beaufort Sea over the development and production life of the project. Onshore spills >1 gal would range from 1,354 to 2,587 (volume of spills ranging from 5,416-10,348 bbl), TAPS pipeline spills >1 gal would range from 108 to 207 (volume of spills ranging from 119-228 bbl), and Alaska North Slope oil-tanker spills >1,000 gal would range from 6 to 14, with a 42- to 91-percent chance of occurring. An onshore pipeline for oil delivery to the TAPS from Alpine and NPR-A development creates the potential for a pipeline spill contaminating the Colville River. Adequate data are not available to estimate a chance of such an occurrence. Records indicate four pipeline leaks, with the largest discharge being 125 bbl (Sec. IV.A.1.b(2)). All NPR-A scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. Adequate data are not available to estimate a chance of such an occurrence. Records indicate four pipeline leaks, with the largest discharge being 125 bbl. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence fishing activity, and curtail the subsistence hunt as resources may well be tainted, or, even if available, the perception of tainting would substantially affect the subsistence harvest (Sec. IV.A.7.13, Subsistence). Summer supply-barge traffic in the open water could create potential impacts from fuel spills to migrating bowhead whales, although normal migration would tend to keep the whales offshore and away from nearshore barge traffic, and fuel supply by barge may not occur.

a. Terrestrial Mammals: Cumulative effects on caribou calving distribution are likely to be long term over the life of the oilfields, but probably local within 1.86 to 2.48 mi (3-4 km) of roads located within calving areas. This reduction in calving and summer habitat use by cows and calves of the CAH and TLH and possibly on WAH caribou from future NPR-A leasing, represents a functional loss of habitat that may result in a long-term effect on caribou herd productivity and abundance. However, this potential effect may not be measurable due to the great natural variability in caribou population productivity. The contribution of the planning-area oil exploration and development activities to the cumulative effects on the TLH (and on WAH caribou from NPR-A wide possible oil exploration and development activities) is estimated to be perhaps 80 to 90 percent and on the CAH, perhaps 10 percent. If global warming occurs during the next several decades with widespread changes in vegetation associated with warming temperatures, much longer term effects on Arctic terrestrial mammals may occur. Cumulative oil development on the Arctic Slope also is likely to result in an increase in abundance of arctic foxes near development areas, which may present a rabies health hazard to humans in the oilfield areas; and the attraction of grizzly bears to human refuse is expected to lead to the loss of bears due to interactions with humans and an eventual decline in bear abundance near development areas. The cumulative effects on muskoxen, moose, wolves, and wolverines (other than global warming) are likely to be local within about 1 to 2 mi of oil exploration and development facilities and resource inventory-survey activities and generally short term, with no significant adverse effects on their populations.

Recent declines in the CAH, but not in adjacent herds, suggest that cumulative activity has already caused changes in long-term caribou abundance and productivity (ADF&G, 1997) (Secs. IV.C.9 and IV.G.9).

b. Fish: Many of the additional activities associated with the cumulative case are not expected to have a significant effect on arctic fish in the planning area. Based on the assumptions discussed in the text, the additional effect of seismic surveys and construction-related activities is expected to be proportional to the number of sales that actually occur. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of seismic surveys and construction-related activities on arctic fish in the cumulative case. The overall effect of these activities may be greater if there is insufficient time for recovery between lease sales. Offshore cumulative-case oil spills are expected to have mostly sublethal effects on the marine and migratory fish affected by them. Cumulative-case oil spills that enter coastal waters are likely to lethally or sublethally affect a greater percentage of arctic fish than estimated for oil spills associated with Alternative I. Assuming sufficient recovery time between spills, the recovery from each cumulative case spill affecting fish is expected within 3 years. Onshore cumulative-case oil spills are expected to have an effect on arctic fish similar to that discussed for Alternative I (Secs. IV.C.7 and IV.E.7). Effects on fish resources from seismic and construction disturbance would increase under the cumulative case with increased chronic, short-term impacts on the subsistence fisheries of Barrow, Nuiqsut, and Atqasuk.

c. Birds: The marine component for the NPR-A sale and subsequent effects on bird populations is likely to be minor, limited to perhaps disturbance from marine vessel traffic and possibly some aircraft traffic. Existing and projected onshore oil and gas development/production activities that may affect bird populations include (among others) Prudhoe Bay, Kuparuk River, Point McIntyre, and the Alpine prospects. In addition, there would be activities associated with future onshore State oil and gas lease sales. Although the potential effects of future onshore sales are speculative, additional disturbance as a result of aircraft and vehicle traffic, construction of drilling pads, pipelines, etc. as a result of new lease sales in the area would be expected. If production from Alpine prospect occurs, a pipeline will be constructed to carry oil to the existing pipelines in the Kuparuk field. The effects on birds as a result of these future activities in these areas are likely to increase only slightly. Most species are not likely to be affected by construction of the Trans-Alaska Gas System.

The overall contribution of proposed activities in the planning area to the cumulative effects on nonendangered birds is expected to be limited primarily to occasional disturbance from aircraft activities, resulting in temporary, nonlethal effects. Disturbance may last less than an hour but could extend to several months in the case of summer drilling operations (Secs. IV.C.8 and IV.G.8).

d. Bowhead Whales: Exposure of bowhead whales to noise-producing activities from both onshore and offshore oil and gas exploration and development and production operations is not expected to result in lethal effects, but some individuals could experience temporary, nonlethal effects. Prolonged exposure of bowhead whales to spilled oil may result in lethal effects on a few individuals, with the population recovering within 1 to 3 years. Most individuals exposed to spilled oil are expected to experience temporary, nonlethal effects. The overall contribution of proposed activities in the planning area to the cumulative effects on bowhead whales is expected to be limited to temporary avoidance behavior in response to vessel and aircraft activities (Secs. IV.C.10 and IV.G.10).

e. Other Marine Mammals (seals, walruses, polar bears, and belukha whales): In the Alaskan Beaufort Sea, cumulative effects of oil and gas development are expected to be relatively short term (within 1 generation or less, perhaps 1-7 years) on ice seals (ringed, spotted, and bearded seals), walruses, polar bears, and belukha whales. In Prince William Sound, the cumulative effects are expected to be longer-term (>5 years) on sea otters and harbor seals. Cumulative effects from other development projects (such as commercial fishing) are expected to be long term (>1 generation to perhaps several generations) on harbor seals, and short term (<1 generation) on other marine mammals. Planning-area activities, including oil exploration and development, are expected to have short-term effects on Arctic marine mammals.

BLANK PAGE

Cumulative effects are generally expected to be relatively short term (within ≤1 generation) on ice seals (ringed, bearded, and spotted seals), walruses, polar bears, and belukha whales and longer term (>1 generation to perhaps several generations) on sea otters and harbor seals. Under Alternative E (with multiple sales and possible NPR-A-wide oil and gas exploration and development), oil resources are estimated to represent 8 percent of the total North Slope production, and production by 2009 could make up 8 to 14 percent (at $18/bbl) of oil carried in tankers in Prince William Sound. As a result, planning-area activities are projected to contribute about 8 percent of the risk of oil-spill mortality and other effects on ice seals, polar bears, walruses, and belukha whales; and 8 to 14 percent of the risk of mortality to sea otters and harbor seals.

Summary: Access to subsistence resources, subsistence hunting, and the use of subsistence resources could be affected by reductions to subsistence resources and changes to subsistence-resource-distribution patterns. Major factors considered in the effects analysis of subsistence-harvest patterns of the communities of Barrow, Atqasuk, and Nuiqsut are: (1) heavy reliance on caribou, birds, fish, and bowhead whales in the annual average harvest; (2) the overlap of subsistence-hunting ranges for many species harvested by the three Native communities; and (3) subsistence hunting and fishing as central cultural values in the Inupiat lifeway. Effects on subsistence resources would have associated effects on subsistence harvests. Oil spills occurring during the winter season could affect sealing and polar bear hunting. In spring, whaling, sealing, and bird hunting could be affected. In the open-water season, whaling, sealing, walrus hunting, and bird hunting could be impacted.

Any perceived disruption of the bowhead whale harvest from oil spills and any tainting or perceived tainting anywhere during the bowhead inmigration, summer feeding, and outmigration could disrupt the bowhead hunt for an entire season, even though whales would not be rendered unavailable. Biological effects to subsistence resources might not necessarily affect species distributions or populations, but disturbance could extend the subsistence hunt, making more frequent and longer trips necessary to harvest enough resources in a given harvest season. Belukha whales, when hunted, can be taken in ice leads and open water; hunting is possible at different times over a 6-month period. This seasonal flexibility could be possible mitigation against noise and disturbance effects. Even though noise and disturbance effects to marine and coastal birds would be short term and local, such disturbance could cause waterfowl to avoid one or more productive subsistence-hunting sites. Cumulative loss of habitat from development activities and population loss from oil spills could cause harvest disruptions that would be significant to subsistence hunters who regard the spring waterfowl hunt to be of primary importance.

The gradual and continual loss of habitat has associated with oil and gas development on the North Slope has been documented in a number of studies (Walker et al., 1986a; Walker et al., 1986b; Walker et al., 1987; Walker, Cate, Brown, and Racine, 1987; Walker and Walker, 1991). Walker et al. (1987) in a geobotanical mapping study concluded that by 1986 the Prudhoe Bay oil field occupied about 500 km^2 between the Kuparuk and Sagavanirktok rivers, that included 359 km of roads, 21 km^2 of tundra covered by gravel and 14 km^2 that had been flooded by road and gravel-pad construction. Growth since 1968 had proceeded at a constant rate, and it was noted that construction at the Kuparuk Field was proceeding at a similar rate, thus doubling the total rate of development. Walker et al. (1987) considered these to be major landscape impacts and recommended that the implications to wetland values, wildlife corridors, and caribou calving grounds be addressed. It was suggested that such studies, which are necessary for assessing cumulative impacts in the region, would be hampered by the lack of baseline information at Prudhoe Bay prior to development, but, nevertheless, methods needed to be developed to assess cumulative impacts so as to foster better comprehensive regional planning on Alaska's Arctic coastal plain. Although recent innovations in the oil industry have reduced the size of an oil field "footprint" (Robertson, 1989), habitat loss needs to continually be assessed and such information used to assess cumulative effects to wildlife populations, subsistence resources, and subsistence harvests (Secs. IV.C.9 and IV.G.9).

Cumulative effects from oil development have been and continue to be paramount concerns to North Slope residents. Kaktovik resident Michael Jeffrey, testifying at hearings for the first offshore oil and gas lease sale, perceived early on a social impact from government actions, stating that there was a cumulative effect on the villagers from having to participate in hearings and meetings. People knew that the issues were important, so they had to take time off from working and hunting to attend. Jeffrey believed the documents to be too technical, and to facilitate villagers' familiarity with them, he suggested that timelines and schedules be extended in non-English speaking communities so that there was enough time to translate documents (Sale BF Public Hearings, May 15, 1979). Sam Taalak, Nuiqsut Mayor in 1982, saw the onslaught of cumulative activity on his village 14 to 15 years ago: "We presently live at Nuiqsut and for the moment we're hemmed in from all sides by major oil explorations, even from the coast front" (Arctic Sand and Gravel Public Teleconference, Anchorage, Jan. 4, 1983). Leonard Lampe, former Nuiqsut vice mayor and present city council member, suggested recently that the village has begun to consider the long-term impact of oil development to their culture: "It's time to look at things seriously and ask if it's worth it. That's what the town is asking itself" (Lavrakas, 1996).

Nuiqsut Village President and AEWC Chairman, Thomas Napageak, in a January 10, 1997, meeting with MMS in Anchorage over a possible Sale 170 Nuiqsut Deferral, explained that the people of Nuiqsut have begun to focus on the issue of cumulative effects; their concern is that when the Northstar project proceeds, it will be out there and impacting the community for 15 to 20 years. The immediate impact of such development (such as Northstar) is directly on Nuiqsut. Mr. Napageak wanted the Sale 170 stipulations to deal with cumulative effects from Sale 170, as well as other projects, and that MMS make it clear in the EIS about cumulative effects. He wanted to see protective language developed for leases in the Sale 170 area that would extend to and bind lessees with existing leases from past sales. He believed such language would cover Nuiqsut's concerns about cumulative effects from other projected development activities (Casey, 1997, pers. comm.) Such language was included in Stipulation 5, Subsistence Whaling and Other Subsistence Activities, instructing lessees to "include a discussion of multiple or simultaneous operations, such as ice management and seismic activities, that can be expected to occur during operations in order to more accurately assess the potential for cumulative effects" (Sale 170 DEIS, USDOI, MMS, 1997). Similar language would be needed in onshore subsistence stipulations for monitoring impacts on subsistence resources and access to those resources. For the Northstar Project, an innovative Citizens' Subsistence Oversight Panel made up of Nuiqsut residents has been proposed. This group would investigate conflicts between subsistence activities and oil exploration and development activities, verify the level of conflict, and propose an action to the lessee and BLM for resolution. An NPR-A version of this panel would provide similar oversight for subsistence/development conflicts in the planning area.

At the NPR-A Nuiqsut scoping meeting, Thomas Napageak noted again the importance of assessing cumulative impacts, especially the cumulative and indirect effects of existing and potential oil development on Nuiqsut. He remarked, "The federal leasing cannot be examined in isolation as though none of this other development and potential development were going on" (Nuiqsut NPR-A Public Scoping Meeting, April 10, 1997). At a BLM symposium on NPR-A held later the same month, Thomas Napageak reaffirmed the importance of addressing cumulative impacts: "Accumulated impact effects that would hinder the community and the socioeconomics of the community, how it will be affected by Alpine and presumably by NPR-A; these..really need to be considered" (USDOI, MMS, 1997).

The BLM, in its 1990 Western Arctic Resource Management Plan, made this assertion about cumulative impacts of development on the North Slope: "To the extent that the planning area bordering lands and seas remain 'open range' geography, subsistence and cultural patterns dependent thereon shall remain open to perpetuation. To the extent that the 'open range' is transected and truncated by developments and their support systems, the subsistence option will be diminished or, at the extreme, closed" (USDOI, BLM, 1990).

Without some mechanism to ensure subsistence hunters access to and through development areas and a protocol for defining "no-fire" zones around development sites, the overall ability to reach subsistence-harvest areas by local subsistence hunters would be restricted, especially in Nuiqsut. No monitoring efforts assessing subsistence-resource damage, resource displacement, changes in hunter access to resources, increased competition, contamination levels in subsistence resources, harvest reductions, increased hunter effort, increased hunter risk, and increased hunter costs have been done or are ongoing. Without a process in place for monitoring harvest patterns and the effectiveness of current mitigation measures, that would necessarily include serious attention to traditional Inupiat knowledge of subsistence resources and practices, no truly informed projection can be made about cumulative effects on subsistence on a systematic and regular basis. The need for an ongoing monitoring effort already has been demonstrated, as initial research has shown that North Slope oil development has produced more regulation of local subsistence pursuits, reduced access to hunting and fishing areas, altered habitat, and intensified the competition by nonsubsistence hunters for fish and wildlife (Haynes and Pedersen, 1989).

Stipulations that would substantially protect subsistence resources and practices from potential proposed oil and gas activities in the planning area include a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on the NPR-A. Additionally, important proposed subsistence stipulations would require lessees:

1. To monitor exploration, development, and production effects on subsistence.
2. To not unreasonably restrict subsistence access by establishing procedures for use and firearm discharge near oil facilities.
3. To notify BLM if conflicts arise between the lessee and subsistence hunters and that BLM resolve the issue.
4. To consult with local communities about siting, timing, methods of operation, and possible mitigation to assure that exploration, development, and production activities are compatible with subsistence practices and

498

to encourage a conflict resolution agreement. Local communities, the NSB, and the Subsistence Advisory Panel all will concurrently review any exploration, development and production plans, and any interested party may request that BLM initiate a dispute resolution process (mediated by a third party), if no conflict resolution agreement is reached.

5. To provide an employee-orientation program that addresses environmental, social, and cultural concerns relating to the NPR-A.
6. To conduct an inventory of known traditional land use sites to develop a plan to avoid these sites and to mitigate any possible damage to them.

Conclusion: Overall cumulative effects to subsistence harvests are expected to cause one or more important subsistence resources to become unavailable, undesirable for use, or experience population reductions for a period of 1 to 5 years in Nuiqsut. In Barrow and Kaktovik, overall cumulative effects to subsistence harvests are expected to cause one or more important subsistence resources to become unavailable, undesirable for use, or experience population reductions for a period of 1 to 2 years. The contribution of the IAP to the cumulative effects in Barrow, Atqasuk, and Nuiqsut would be to affect subsistence resources, especially the subsistence caribou hunt, for up to an entire season (1 year), making their pursuit more difficult (with hunters having to travel farther than normal to harvest them). In all three communities, an oil spill affecting any portion of the bowhead whale migration route may well taint this culturally important subsistence resource, or, even if available, the perception of tainting could substantially affect the desirability of bowheads and curtail the subsistence harvest (see Sec. IV.C.13, Subsistence for a discussion of effects-level definitions).

14. Sociocultural Systems: Cumulative effects on sociocultural systems include effects of multiple lease sales in the NE NPR-A Planning Area and other ongoing or planned projects on the North Slope that would include Federal and State offshore lease sales and State and private activities expected to occur in the future. Nearby developments include future State of Alaska oil and gas lease sales (9 areawide sales including both on and offshore tracts over the next 5 years), offshore development of the Northstar project, potential development in the Kuvlum and Hammerhead units and at the Liberty prospect (Tern Island), development of the Alpine oil and gas field in the Colville River delta area, OCS Oil and Gas Lease Sale 144, and future OCS Oil and Gas Lease Sales 170 and 176 in the Beaufort Sea in the years 1998 and 2000, respectively. Additionally, LNG tankering from a potential facility near Valdez for TAGS natural gas and potential crude-oil tankering to the Far East from the port of Valdez are considered. The probability of any or all of the ongoing and planned offshore and onshore projects reaching the development and production stage is unknown; however, the following discussion assumes that all of these projects would reach the development and production stage. As discussed in the previous alternative analyses, the effects of projects in the cumulative case on sociocultural systems would occur because of changes in social organization, cultural values, and other issues, such as stress on social systems.

a. Social Organization: In the cumulative case, effects on social organization could result from industrial activities, changes in population and employment, and changes in subsistence-harvest patterns. These effects would be similar to those described for the IAP; however, the level of effects would be increased because of the intensity of activity in the cumulative case. Additional air traffic and growth in the number of non-Natives in the North Slope region could increase the interaction between Natives and non-Natives and could cause additional stress between these groups, although non-Native workers would continue to work in enclaves and, in so doing, mitigate much of the expected increase in interaction.

Increases in population growth and employment would be long term in the cumulative case and could cause disruptions to (1) the kinship networks that organize the Inupiat communities' subsistence-production and -consumption levels, (2) extended families, and (3) informally derived systems of respect and authority (primarily respect of elders and other leaders in the community). Offsetting such effects are strong efforts by the NSB government, the AEWC, and local governments and village corporations to institutionally foster and protect Inupiat cultural traditions. Cumulative-case effects on subsistence-harvest patterns (which also would be long term in the cumulative case) would affect the Inupiat social organization through disruptions to kinship ties, sharing networks, task groups, crew structures, and other social bonds. Effects on sharing networks and subsistence-task groups could cause a breakdown in family ties and the communities' well-being as well as tensions and anxieties, leading to high levels of social discord. The NSB, the AEWC, and local whalers have set precedents for the negotiation of agreements with the oil industry to protect subsistence-whaling practices. Such cooperation continues in the Citizens' Subsistence Oversight Panel proposed for the Northstar Project. This group would investigate conflicts between subsistence activities and oil exploration and development activities, verify the level of conflict, and propose an action to the lessee and BLM for resolution. In the cumulative case, disruptions to sociocultural systems would be chronic and long term (2-5 years), but there would be no tendency toward the displacement of existing institutions and existing social organization.

b. Cultural Values: In the cumulative case, effects on cultural values could result from industrial activities, changes in population and employment, and changes in subsistence-harvest patterns. These effects would be similar to those described for the IAP; however, the level of effects would be higher due to the intensity of activity in the cumulative case. Cumulative-case effects on the social organization could lead to a decreased emphasis on the importance of the family, cooperation, sharing, and subsistence as a livelihood, and to an increased emphasis on individualism, wage labor, and entrepreneurialism. In the cumulative case, long-term effects on subsistence-harvest patterns are expected. Chronic, long-term disruptions of subsistence-harvest patterns could affect subsistence-task groups and have a tendency to displace sharing networks, but there would be no tendency toward the displacement of subsistence as a cultural value. These cultural values would be afforded the same protection by NSB institutions, the AEWC, community whaling organizations, and regional and village corporations.

c. Other Issues: Increases in social problems, such as rising rates of alcoholism and drug abuse, domestic violence, wife and child abuse, rape, homicide, and suicide also are issues of concern in the cumulative case. The NSB already is experiencing social problems in its communities, and additional development (including onshore and offshore oil development) on the North Slope would lead to further disruptions of social health and well-being. Historically, it is suggestive that abuse of alcohol and increased violence seem to be somewhat connected to the increased flow of income into North Slope communities. During the peak of commercial whaling and then again during the height of the fur trade, secondary sources have indicated the onset of socially dysfunctional behavior. During the economic declines following these periods, drinking and violence seemed to ebb. Recent evidence of the effects of employment during and just after World War II loosely substantiate this generalization. Lacking clear, incontrovertible evidence, it still could be assumed that the significant social changes encouraged and abetted by the huge cash flows from onshore oil development to date have played at least some role in the expression of these problems. It also is likely that these social changes in the North Slope have contributed to the extremely high rate of suicide among the Inupiat (90.8 per 100,000 for the Inupiat vs. 35 per 100,000 among the Yup'ik [Travis, 1989]). Long-term effects in the cumulative case could cause a displacement of existing sociocultural institutions, but again, the NSB continues to vigilantly protect the rights and culture of the Inupiat. A recent struggle to prevent liquor sales in Barrow was successful largely due to the initiative of the former mayor and assembly of the NSB, but the struggle to keep Barrow "dry" continues to be an ongoing ordeal with referendums constantly being proposed to bring the issue to yet another vote.

Although not long term, activities associated with oil-spill cleanup (associated with the estimated 1-2 spills ≥1,000 bbl occurring over the life of the field and elsewhere) could generate up to 300 jobs for cleanup workers. For local Native residents employed in cleanup work (based on occurrences during the *Exxon Valdez* spill cleanup), there could be curtailed participation in subsistence activities, a large cash surplus to spend, and a tendency to not continue employment in other local, lower paying jobs in the community. This sudden and dramatic increase in income for local Native cleanup workers and the disruption or inability to pursue subsistence because of oil-spill disruption and oil-spill cleanup employment could cause tremendous social upheaval. Nevertheless, many village men have been trained in oil-spill cleanup procedures and have expressed a desire to be part of any oil-spill-cleanup response, and it is expected that the NSB would have a large part in the structure of any oil-spill response and cleanup.

Conclusion: Because of its proximity to most ongoing oil-development activities on the North Slope, cumulative effects on sociocultural systems could cause chronic disruption to the sociocultural systems in the community of Nuiqsut for a period of 2 to 5 years, with a tendency toward the displacement of existing institutions and social organization. Barrow and Atqasuk could experience chronic disruption to sociocultural systems for a period of 1 to 2 years, with no tendency toward displacing existing institutions or social organization. The contribution of the IAP to the cumulative effects would be disturbance effects that could disrupt sociocultural systems for an entire season (1 year) and create disruption to institutions and sociocultural systems, but these disruptions are not expected to displace ongoing sociocultural institutions, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.

15. Coastal Zone Management: The discussion of activities under the cumulative case is limited to oil and gas activities and includes both past and proposed Federal and State lease sales and infrastructure and transportation scenarios. These projected activities are in addition to those associated with Alternative E in the planning area. They include additional lease sales in the northeastern NPR-A, additional lease sales in the remainder of the NPR-A, current and projected North Slope oil-development projects, former Federal and State oil and gas lease sales, and the transportation of oil and gas by pipeline. A detailed discussion of these activities or proposed actions and scenarios can be found in Section IV.A.5. The probability of any or all of the ongoing and planned offshore and onshore projects reaching the development and production stage is unknown. However, for analysis of cumulative effects, it is assumed these projects would reach the development and production stage.

As with the proposed action, the effects of the projects considered in the cumulative case would occur from oil spills, noise disturbance from seismic survey activities, air and road traffic disturbance, disturbance from construction activities associated with pipelines, oil facilities (construction, installation, and operation), roads and landfalls, supply efforts, and oil tankering. Cumulative effects of multiple lease sales in the planning area and other ongoing or planned projects on the North Slope that would include Federal and State onshore and offshore lease sales, and State and private activities expected to occur in the future likely will increase potential conflicts with coastal management policies of the ACMP and NSB CMP.

The probability of the North Slope experiencing the effects of one or more oil spills is substantially higher in the cumulative case than it is for Alternative E, the maximum-resource alternative. In the cumulative case, oil-spill-occurrence estimates indicate a total of 1 to 2 spills >1,000 bbl from offshore pipelines and platforms from Federal and State activity, with an estimated 71- to 88-percent chance of occurring in the Alaskan Beaufort Sea over the development and production life of the project. Onshore spills >1 gal would range from 1,354 to 2,587 (volume of spills ranging from 5,416-10,348 bbl), TAPS pipeline spills >1 gal would range from 108 to 207 (volume of spills ranging from 119-228 bbl), and Alaska North Slope oil-tanker spills >1,000 gal would range from 6 to 14, with a 42- to 91-percent chance of occurring. All NPR-A scenarios call for an onshore pipeline for oil delivery to the TAPS, and there is the potential for a pipeline spill contaminating the Colville River. Adequate data are not available to estimate a chance of such an occurrence. Records indicate four pipeline leaks, with the largest discharge being 125 bbl. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence fishing activity, and curtail the subsistence hunt as resources may well be tainted, or, even if available, the perception of tainting would substantially affect the subsistence harvest (Sec. IV.C.13, Subsistence). Summer supply-barge traffic in the open water could create potential impacts from fuel spills to migrating bowhead whales, although normal migration would tend to keep the whales offshore and away from nearshore barge traffic, and fuel supply by barge may not occur.

Cumulative effects may lead to changes in the level of effects or may involve policies that were not relevant to Alternatives E, the maximum resource scenario. These differences are the focus of this analysis. Many of the projects included in the cumulative case could occur on Federal and State onshore and offshore lands, as well as lands covered by the NSB LMR's. Because the LMR's areawide policies are the same as those developed by the NSB for the NSB CMP, the areawide policies of the LMR's are incorporated into the section on coastal management.

a. ACMP Standard for Energy Facilities (6 AAC 80.070) and Transportation and Utilities (6 AAC 80.080): The effects of pipelines, roads, and facilities installation and construction are magnified in the cumulative case. Cumulative loss of bird habitat, if all the potential projects are developed, could be substantial and have locally significant effects on nesting distribution or density of some bird species near roads and facilities. If an extensive network of pipelines and associated roads were to bisect important calving areas, effects would be greater. The cumulative case results in an increased potential for conflict with 6 AAC 80.070(b)(1)(2) and (13) and NSB CMP 2.4.5.1(g) (NSBMC 19.70.050.J.7).

b. ACMP Subsistence standard (6 AAC 80.120): The increase in the range and number of activities associated with possible interference with subsistence activities and potential loss of access and resources would accentuate potential conflicts with the Statewide standard that guarantees opportunities for subsistence use of coastal areas and resources and the NSB CMP policies that are addressed in Section IV.C.15. The duration of the potential user conflicts may cause subsequent developments to fall into a more restrictive policy. Cumulative effects on marine mammals from noise and disturbance of most subsistence species are expected to be limited to temporary avoidance behavior in response to vessel and aircraft activities, and are not expected to affect their overall abundance, productivity, or distribution. Cumulative effects from oil spills could oil and contaminate these species and/or their habitats, resulting in low to moderate mortality rates. Planning-area activities, including oil exploration and development, are expected to have short-term effects on Arctic marine mammals.

Cumulative effects on caribou are expected to be long term, particularly the cumulative effects on caribou calving distribution are likely to be long term over the life of the oilfields, possibly affecting local subsistence harvests. Reduction in calving and summer habitat use by cows and calves of the CAH and TLH and possibly on WAH caribou from future NPR-A leasing, represents a functional loss of habitat that may result in a long-term effect on caribou herd productivity and abundance. The contribution of the planning-area oil exploration and development activities to the cumulative effects on the TLH (and on WAH caribou from NPR-A wide possible oil exploration and development activities) is estimated to be perhaps 80 to 90 percent and on the CAH, perhaps 10 percent. The cumulative effects to other terrestrial mammals, including grizzly bears, muskoxen, moose, wolves, and wolverines (other than global warming) are likely to be local within about 1 to 2 mi of oil exploration and development facilities and resource inventory-survey activities and generally short term, with no significant adverse effects on their populations.

Cumulative effects from potential oil spills and onshore disturbance to fishes are expected to be local and temporary. Cumulative-case oil spills that enter coastal waters are likely to lethally or sublethally affect a greater percentage of arctic fish than estimated for oil spills associated with Alternative E. Assuming sufficient recovery time between spills, the recovery from each cumulative case spill affecting fish is expected within 3 years. Onshore cumulative-case oil spills are expected to have an effect on arctic fish similar to that discussed for Alternative E (Secs. IV.C.7 and IV.E.7). Effects on fish resources from seismic and construction disturbance would increase under the cumulative case with increased chronic, short-term impacts on the subsistence fisheries of Barrow, Nuiqsut, and Atqasuk.

Cumulative effects to birds for the NPR-A sale and subsequent effects on bird populations is likely to be minor, limited to perhaps disturbance from marine vessel traffic, aircraft activity, and future development activities, resulting in temporary, nonlethal effects. Disturbance may last less than an hour but could extend to several months in the case of summer drilling operations (Secs. IV.C.8 and IV.G.8).

Cumulative effects from exposure of bowhead whales to noise-producing activities from both onshore and offshore oil and gas exploration and development and production operations are not expected to result in lethal effects; but some individuals could experience temporary, nonlethal effects. Prolonged exposure of bowhead whales to spilled oil may result in lethal effects on a few individuals, with the population recovering within 1 to 3 years. Most individuals exposed to spilled oil are expected to experience temporary, nonlethal effects. (Secs. IV.C.10 and IV.G.10).

In the Beaufort Sea, cumulative effects to other marine mammals (seals, walruses, polar bears, and belukha whales) from of oil and gas development are expected to be relatively short term (within ≤1 generation, perhaps 1-7 years) on ice seals (ringed, spotted, and bearded seals), walruses, polar bears, and belukha whales. In Prince William Sound, the cumulative effects are expected to be longer- term (>5 years) on sea otters and harbor seals. The cumulative effects from other development projects (such as commercial fishing) are expected to be long term (>1 generation to perhaps several generations) on harbor seals, and short term (<1 generation) on other marine mammals.

Rather than considering subsistence access reduced or restricted (NSB CMP 2.4.5.1[b]) (NSBMC 19.70.050.J.2), it may be considered precluded and be subject to NSB CMP 2.4.3(d) (NSBMC 19.70.050.D) instead. It is possible that some subsistence resources could be depleted below the subsistence needs of local residents (NSB CMP 2.4.3[a] and NSBMC 19.70.050.A).

c. Habitats Standard (6 AAC 80.130): All habitats noted as at risk for Alternative E, the maximum resource scenario, are more likely to be adversely affected in the cumulative case. This could lead to conflict with the ACMP Statewide standard and the NSB CMP habitat policies identified in Section IV.C.15. One policy that likely will be implemented with greater scrutiny in all habitats is the policy that curtails vehicles, vessels, and aircraft activity when and where it may affect concentrations of sensitive populations (NSB CMP 2.4.4[a] and NSBMC 19.70.050.I.1). Potential effects resulting from noise and disturbance on birds, mammals, waterfowl, and caribou all increase in the cumulative case.

In the offshore habitat, increased effects relate to the increased number of oil spills and development of roads and facilities over the life of the fields. The NSB CMP policy 2.4.4(i) (NSBMC 19.70.050.I.9), identified previously under transportation, will receive greater attention with respect to the offshore habitat.

Development of State leases included in the cumulative case increases the likelihood that barrier islands and lagoons would be affected. Disruptive activities and requests for altering shores are probable, because this habitat is within the area leased by the State for oil and gas exploration and development.

The cumulative case analysis also considers effects to the tundra wetlands that would be subject to infilling. Adverse effects on tundra and wetland nesting, feeding, and staging areas, particularly in the Teshekpuk Lake waterfowl-concentration area, the NPR-A oil-exploration and -development area, and the Mackenzie River Delta oil development in Canada, are likely to represent a greater loss of tundra habitat on the North Slope for several species and may have a long-term, local effect on the nesting distribution and density of some species for more than one generation (or over the life of the oilfields).

Pipeline and road crossings and gravel extraction would increase in riverine areas that are used extensively by anadromous fishes. Although this could lead to greater conflict with the riverine-habitat policy, development probably would be modified if conflict with this policy became evident.

d. ACMP Air, Land, and Water Quality Standard (6 AAC 80.140): Greater adverse effects for water quality are expected for the cumulative case:

however, regional water quality in the Beaufort Sea would not be affected. Conflict with the ACMP Statewide standard and district policies could occur only if it were not consistent with Federal or State water-quality standards.

Air quality in the cumulative case would be the same, qualitatively, as that discussed in Alternative E. Effects on onshore air quality for cumulate-case emissions are expected to be low. These effects would not make the concentrations of criteria pollutants in the onshore ambient air approach the air-quality standards. Conflict with NSB CMP policies is not anticipated. The NSB CMP 2.4.3(h) (NSBMC 19.70.050.H) also requires that development comply with Federal and State air-quality standards. The NSB CMP 2.4.4(c) (NSBMC 19.70.050.I.3) identified airborne emissions specifically as needing to meet the standards. Acidification of tundra vegetation is not covered under air-quality standards but would be covered under several elements, either in the facility-siting standard or the wetland-habitat standard. Emissions estimated for the cumulative case are not expected to be sufficient to harm vegetation.

Conclusion: In the cumulative case, the contribution of other Federal and State onshore and offshore oil and gas lease sales increases the potential for conflicts with the coastal management policies identified under Alternative E, the maximum resource scenario (user conflicts between development activities and access to subsistence resources, adverse effects on subsistence resources, habitats, and water quality). Additionally, the cumulative case presents the potential for conflict with two more policies: energy-facility siting and transportation and utilities. Overall cumulative effects to subsistence harvests are expected to cause one or more important subsistence resources to become unavailable, undesirable for use, or experience population reductions for a period of 1 to 5 years in Nuiqsut. In Barrow and Kaktovik, overall cumulative effects to subsistence harvests are expected to cause one or more important subsistence resources to become unavailable, undesirable for use, or experience population reductions for a period of 1 to 2 years. The contribution of the NPR-A sale to the cumulative effects in Barrow, Atqasuk, and Nuiqsut would be to affect subsistence resources, especially the subsistence caribou hunt, for up to an entire season (1 year), making pursuit more difficult (with hunters having to travel farther than normal to harvest them). For all three communities, an oil spill affecting any portion of the bowhead whale migration route may well taint this culturally important subsistence resource, or, even if available, the perception of tainting could substantially affect the desirability of bowheads and curtail the subsistence harvest (Section IV.4.G.15).

16. Recreation and Visual Resources:

Cumulative impacts would be a result of: (1) long-term impacts resulting from development pads and pipelines; (2) the "midterm" (2-5 years) impacts from green pads and green trails caused by overland moves, exploratory drilling, and seismic work; and (3) short-term impacting activities such as overflights, camps, and seismic trains. Cumulative impacts would be greatest in areas of high oil and gas potential. Short- and mid-term impacts result in a momentary relationship to the total of cumulative impacts.

Conclusion: Overall, cumulative impacts would be similar in nature and intensity to those described for Alternative E.

H. UNAVOIDABLE ADVERSE EFFECTS ON:

1. Soils: Development destroys soils; where development is authorized or permitted there will be an unavoidable loss of soils. Soils buried or truncated during oil development are lost.

2. Paleontological Resources: Unavoidable adverse effects to paleontological resources, should they occur, would result directly from oil and gas exploration and development activities and facilities such as drill pads and pipelines. Future technological advances may reduce the likelihood of such impacts.

3. Water Resources: Uunavoidable adverse effects of oil and gas exploration and development would result from construction activities associated with road and pad construction, culvert and bridge work in streams and lakes that disturbs stream banks or shorelines, blockages of natural channels and floodways that disrupt drainage patterns, increased erosion and sedimentation, and removal of gravel and water from riverine pools and lakes.

The short-term effect of construction activity would be some subsidence of the ice-rich permafrost along the stream banks and lakeshores, especially in areas where the wave action of the water would accelerate the removal of the degrading protective cover. Fine-grained sediments melting out of the ice-rich permafrost would result in increased sediment erosion and changes to stream-channel and -bed morphology. Water removal from pools and lakes may have short-term effects on aquatic and other resources.

4. Water Quality: Unavoidable adverse effects on water quality would occur from seismic trails and ice-road construction, which could affect water quality over hundreds of acres.

5. Air Quality: An increase in emissions of air pollutants would occur as a result of the proposed action. In all the alternatives and the cumulative case, the additional emissions are not expected to be significant. In the event that any emissions are significant, they may be reduced by existing methods as necessary. For the proposed action, the limits to air-quality-standards would not be approached.

6. Vegetation: All of the impacts to vegetation described for Alternatives A through E are unavoidable given the occurrence of the activities causing them. However, not all of these impacts can definitely be judged as adverse, while some of those that are adverse would have effects for only a short period. Those impacts caused by oilfield development, such as burial of vegetation under gravel fill and contamination by oil spills, would have obvious adverse effects. However, those impacts that may cause plant-composition change, such as snow drift and dust accumulation, account for about 65 percent of oilfield-development impacts on an acreage basis. These types of impacts would have an adverse effect on the plant community replaced and its associated fauna but a beneficial effect on the plant communities and fauna that colonize those areas.

7. Fish: Unavoidable adverse effects associated with Alternative E may occur due to seismic surveys, construction-related activities, and oil and fuel spills. Seismic surveys located above or near overwintering areas may have lethal effects on some juvenile fish overwintering there. However, these events are likely to be infrequent and they are not expected to have a measurable effect on Arctic fish populations. Under-ice withdrawls from areas having water and dissolved-oxygen levels barely to moderately sufficient to support overwintering fish would be likely to kill 50 to 100 percent of the fish overwintering there (an estimated 5-10-year recovery). Withdrawls from freshwater sources that do not support resident fish populations, or from areas having sufficient under-ice reserves of water and dissolved oxygen, are not likely to adversely affect overwintering fish. Gravel pad and road construction in high-density spawning and overwintering areas, or in access corridors used by migratory fish, is expected to result in spawning failure and fish mortality in 50 to 100 percent of the fish affected (estimated 10-year recovery). Construction in low-diversity areas sparsely inhabited by large fish during nonmigratory periods, and where siltation is minimized and fish passage is not impaired, is expected to reduce spawning failure and fish mortality to <5 percent of the fish affected and recovery to 1 year. Oil and fuel spills are expected to lethally or sublethally affect <1 percent of the fish in the planning area over the production life of the field. Recovery from each spill affecting fish is expected within 3 years. The probability of the above effects occurring and affecting arctic fish populations is estimated to be roughly 5 to 6 times higher for Alternative E than for Alternative B.

8. Birds: Disturbance of some individuals by noise and/or visual presence of aircraft, ground vehicles, or personnel associated with management action activities such as wildlife aerial surveys, resource surveys, camp maintenance, float trips, hunting, and winter transport, as well as routine oil and gas exploration and development activities such as seismic surveys, air and ground traffic, construction, and drilling Under Alternatives B through E, is considered unavoidable. However, many of these potentially disturbing activities, particularly those associated with oil and gas development, are expected to be mitigated through adoption of the proposed stipulations. Because birds are likely to be most disturbed by aircraft, and management action activities involving air support such as aerial wildlife surveys are exempted from aircraft-seasonal restrictions, they may cause temporary, localized effects on birds.

9. Mammals:

a. Terrestrial Mammals: Some surface-vehicle disturbance of caribou during the calving season and some habitat alterations from planning-area oil development under Alternatives B through E probably are unavoidable. This displacement or reduced habitat use by caribou of the Teshekpak Lake and Central Arctic caribou herds is likely to be local (within 1.86-2.48 mi (3-4 km) of oilfield roads and along pipeline corridors) and long term (>1 generation) and perhaps persist over the life of the oilfields. Some noise and disturbance of other terrestrial mammals may be unavoidable but are expected to be short term and local and not significantly affect mammal populations.

b. Marine Mammals: Most oil spills are considered unavoidable, while most human disturbance of marine mammals is considered avoidable through voluntary compliance with the BLM stipulations on air traffic.

If an onshore fuel- or crude-oil spill occurred in the Teshekpuk Lake area and reached the marine environment, such a spill could perhaps result in the unavoidable loss of a small number of seals and polar bears, with recovery likely to occur within 1 year.

10. Endangered and Threatened Species: Most sale-related marine-vessel traffic and the disturbance of bowhead whales as a result of such traffic is unavoidable. However, any disturbance associated with marine-vessel traffic is likely to be very minimal and very localized. Some bowhead whales may interact with marine-vessel traffic, and some inadvertent conflicts or incidental "taking" situations may occur. These inadvertent conflicts with or incidental "taking" situations of some individual whales as a result of marine-vessel traffic would not constitute a threat of harm to the species.

Spectacled and Steller's eiders are most likely to be disturbed by aircraft traffic. Most disturbance caused by oil and gas activities can be mitigated through the proposed stipulations pertaining to seismic surveys, facility design and construction, ground transportation, air traffic, and oil and gas exploratory drilling. However, some of the activities other than oil and gas exploration and development under the management plan, such as aerial wildlife surveys and other aerial surveys, are exempted from the aircraft-flight-timing restrictions and may cause temporary, nonlethal effects on eiders. Disturbance of some individuals over the life of the project is expected to be unavoidable.

11. Economy: Unavoidable effects on the economy generally are considered positive rather than adverse, but some people consider any one or a combination of them as adverse. Production is projected to generate increases above the levels without Alternative E as follows. NSB property taxes, 3 to 6 percent ($6-$12 million); direct oil-industry employment, 700 to 1,400 (5 x this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 2 to 5 percent; and annual revenues to the State of $1.5 to $3 million, $2.5 to $10 million, and $1.25 to $5 million from property tax, royalty income, and severance tax, respectively.

12. Cultural Resources: Unavoidable adverse effects to cultural resources, should they occur, would result directly from oil and gas exploration and development activities and facilities such as drill pads and pipelines. Future technological advances may reduce the likelihood of such impacts.

13. Subsistence-Harvest Patterns: Noise and traffic disturbance and a potential barge fuel-spill incident that are unavoidable could lead to the localized, direct losses of small numbers of belukha whales, seals, walruses, and polar bears. Noise and traffic disturbance would produce chronic, local, short-term impacts on caribou, other terrestrial mammals, fish, and birds; however, none of these losses would lead to elimination of any subsistence harvest. Only disturbance effects on caribou could lead to a reduction of total annual harvests by making their pursuit more difficult for subsistence hunters. Other effects on other species and harvests due to noise and traffic disturbance and construction activities are expected to be avoidable if mitigated, thus decreasing the overall level of effects from these sources.

14. Sociocultural Systems: Federal, NSB, and community-supported social programs with adequate funding would mitigate many of the sociocultural consequences of oil and gas development in the planning area. One area of unavoidable adverse effects involves the potential repercussions to the sharing of subsistence resources. Unavoidable effects on subsistence harvests, primarily from disturbance to caribou, could disrupt sociocultural systems for an entire season (1 year) and create disruption to institutions and sociocultural systems; but these disruptions are not expected to displace ongoing sociocultural institutions; community activities; and traditional practices for harvesting, sharing, and processing subsistence resources.

15. Coastal Zone Management: Noise and traffic disturbance and a potential barge fuel-spill incident that are unavoidable could lead to the localized, direct losses of small numbers of belukha whales, seals, walruses, and polar bears. Noise and traffic disturbance would produce chronic, local, short-term impacts on caribou, other terrestrial mammals, fish, and birds; however, none of these losses would lead to elimination of any subsistence harvest. Disturbance typically is considered an unavoidable effect. Other effects on other species and harvests due to noise and traffic disturbance and construction activities are expected to be avoidable if mitigated, thus decreasing the overall level of effects from these sources.

Unavoidable adverse effects from oil and gas leasing in the NPR-A from oil spills, noise and disturbance from construction and transportation. To the extent that facilities are sited to minimize effects of oil spills on the environment and on subsistence harvest patterns, conflicts with the Statewide standards and the NSB policies of the ACMP are avoidable; therefore, it is expected that activities generally will conform with existing policies of Federal, State, and local coastal management programs.

16. Recreation and Visual Resources: Unavoidable adverse effects to scenic quality, solitude, naturalness, and primitive/unconfined recreation would occur from oil and gas exploration and development. These effects would be a direct result of oil and gas exploration and development activities and facilities such as drill pads and pipelines. Recent and future technological advances may make green trails and pads an avoidable impact.

BLANK PAGE

I. RELATIONSHIP BETWEEN THE LOCAL SHORT-TERM USES AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY: The short-term effects and uses of various components of the environment in and adjacent to the Northeast NPR-A Planning Area are related to long-term effects and the maintenance and enhancement of long-term productivity. Short term refers to the period during which oil and gas production would occur within the planning area. This is roughly 36 years. Long term refers to an indefinite period beyond the termination of oil and gas production. The effects of the activities associated with the IAP would vary in kind, intensity, and duration, beginning with preparatory activities (seismic-data collection and exploration drilling) of oil and gas development, and ending when natural environmental balances might be restored.

Many of the effects discussed in Section IV are considered to be short term (being greatest during the construction, exploration, and early production phases) and could be further reduced by the stipulations noted in the stipulations described in Appendix B.

1. Physical Resources: The adverse effects of oil and gas exploration and development would result in both short-term and long-term change to the water resources. Construction activities associated with road and pad construction, culvert and bridge work in streams and lakes that disturb stream banks or shorelines, blockages of natural channels and floodways that disrupt drainage patterns, and removal of gravel would cause short-term increases in erosion and sedimentation. Water removal could cause short-term changes in aquatic habitat. Permanent gravel roads and pads, airstrips, pipelines, and facilities constructed adjacent to or crossing streams and lakes would have long-terms effects on water resources. Magnitude and duration of effects would vary with the type and extent of the activities.

Degradation of onshore water quality from construction and operation of oilfield(s), eroding seismic trails, and from connecting winter ice roads, would be a long-term effect. Onshore and offshore spills would be short-term effects on water quality.

2. Paleontological Resources: Paleontological resources are nonrenewable. Once a paleontological resource locale is physically impacted, it cannot be reclaimed. Therefore, impacts would be permanent, and there would be no rehabilitation.

3. Biological Resources: Most effects on vegetation of management actions other than oil development would be short term. The construction of well collars for exploration wells and the most severe impacts of vehicles during overland moves and seismic exploration would affect vegetation for the long term. All effects on vegetation of oilfield construction would be long term. Oil spills and dust and gravel spray from vehicular traffic on the gravel pads would not occur after field abandonment. The recovery time for vegetation from prior spills would extend only briefly into the long term (Jorgenson, 1997), but it is not known how long plant-community changes from dust effects would persist. Although research indicates that natural plant communities can be restored to gravel pads (McKendrick, 1997), especially if some silt- loam soil is added to the substrate, the time until recovery of a natural canopy cover would be so long that the impacts may be considered permanent from a human perspective. As a result, the long-term productivity of these localized areas would be reduced, but these areas represent less than 0.1 percent of the planning area.

Noise disturbance as a result of ground impacting management actions, including oil and gas activities could have potential short-term effects on the biological populations and their habitats and might have long-term effects. Effects would vary with the type and magnitude of the various activities.

Short-term, localized, adverse effects on biological populations and habitats could occur in the event of an oil spill, although oil spills associated with the planning area are expected to be small and not likely to affect a large area. Oil spills in the marine environment are not likely to occur. Potential effects include mortality of individuals, physiological stresses in surviving individuals, reduction in the number of species or species populations in the affected area, changes in the distribution of species or individuals, and changes in behavior or migration patterns. Long-term, cumulative effects might occur if recovery from the short-term effects extended beyond the estimated useful life of the proposed action. Some species might have difficulty repopulating physically altered habitats and could be permanently displaced.

The potential effects of noise disturbance and terrestrial habitat alteration may also include short-term, localized effects such as mortality, stress, population or species decreases or redistribution, and changes in survival patterns. Long-term effects might occur if recovery from the short-term effects extended beyond the estimated useful life of the proposed action. Also, long-term biological productivity could be lost from those areas that have been assumed as facility sites in support activities of the proposed action.

4. Socioeconomic Systems: Increased employment, population, industrial activity, revenues, and oil spills that might occur as a result of the IAP all contain the potential for disrupting Native communities in the NSB and communities in Southcentral Alaska in the short term and could contribute to long-term consequences.

The production of oil and gas from the NPR-A would provide short-term energy and, perhaps, provide time either for the development of long-term alternative-energy sources or substitutes for petroleum feedstocks. Economic, political, and social benefits would accrue from the availability of oil and gas. Most benefits would be short term and would decrease the Nation's dependency on oil imports. Regional planning would aid in controlling changing economics and populations and, thus, in moderating any adverse effects. If additional supplies were discovered and developed, the proposed production system would enhance extraction. However, consumption of this oil and gas would be a long-term use of nonrenewable resources.

The redistribution or reduction of species populations in the short term could affect regional subsistence-harvest patterns. Such short-term effects on subsistence-harvest patterns from the proposed action would not be expected to have long-term consequences except as a source of social disruptions or unless chronically imposed on the resource base of the region. Habitat destruction also might cause a local reduction in subsistence species, which could threaten the regional economy.

Increased population and industrial activity, and minor gains in revenues and employment that might occur as a result of the proposed action all contain the potential for disrupting Native communities in the short term. In addition, changes brought about by leasing in the planning area could be a participating factor in long-term consequences for Native social and cultural systems.

There is a negative relationship between short-term uses and long-term productivity of recreation and visual resources. Rehabilitation and removal of pads and facilities can, at best, achieve (a perception of) the original condition. If airstrips are not removed and/or rehabilitated, then recreation opportunities in that area could be enhanced by providing access. Scenic quality, naturalness, and primitive/unconfined recreation still would be negatively impacted.

5. Cultural Resources: Cultural resources are nonrenewable. Once a cultural resource locale is physically impacted, it cannot be reclaimed. Therefore, impacts would be permanent, and there would be no rehabilitation.

508

J. Irreversible And Irretrievable Commitment of Resources: Estimates of undiscovered, economically recoverable resources are based on the areas proposed for leasing and the price of produced crude oil, which is assumed to range from $18 to $30 per barrel (Appendix A). For the Northeast NPR-A Planning Area, four alternatives have been proposed (Sec. II.D.1) that would allow oil and gas leasing. These alternatives and associated resource estimates are shown in Table IV.J-1. Should these resources be recovered, they would be irretrievably consumed. Following are discussions of the assumed effects of this commitment of resources on:

1. Effects on Soils: Soil formation is a very slow process; development of definitive soils in dynamic equilibrium with their environment may take centuries. This process of soils formation is especially slow in the planning area where there are low temperatures and short growing seasons. Thus from a historical perspective, destruction through burial or truncation may be considered an irretrievable commitment of soils.

2. Paleontological Resources: Paleontological resources are nonrenewable. Once a paleontological resource locale is physically impacted, it cannot be reclaimed.

3. Water Resources: The adverse effects of oil and gas exploration and development would result in both short-term and long-term change to the water resources. Construction activities that disturb stream banks or lake shorelines, temporary blockages of natural channels, and removal of gravel would cause short-term increases in erosion and sedimentation. Water removal could cause short-term changes in aquatic habitat. Permanent gravel roads and pads, airstrips, pipelines, and facilities constructed adjacent to or crossing streams and lakes would have long-term effects on water resources. Removal of these structures from streams and lakes after production ceases would restore drainage patterns and natural sedimentation processes. Irretrievable changes could occur where thermokarst has caused major changes in stream banks or lake shorelines or altered natural drainage patterns.

4. Water Quality: Thermokarst erosion along seismic trails, gravel roads, and pads could result in degraded water quality that would last long after the life of the field(s). There would be no irreversible or irretrievable effect on water quality.

5. Air Quality: Air quality would be affected by well drilling, construction activities, and production. These effects would occur only during the life of the field(s). There would be no irreversible or irretrievable effects on air quality.

6. Vegetation: The vegetation communities of Alaska's North Slope evolve through several phases over periods of decades or centuries. This is especially true for the Arctic Coastal Plain, where ice and thaw lakes cause a constantly changing landscape (Bergman et al., 1977). Therefore, plant-community changes resulting from dust or snow drift accumulations would not be considered irreversible. The burial of vegetation under gravel fill is a different situation. The potential recovery of vegetation on these pads would take such a long time that, from a human perspective, this may be considered an irretrievable commitment of vegetation resources.

7. Fish: Arctic fish in the planning area would be exposed to overland seismic surveys, construction-related activities, and oil and fuel spills associated with Alternative E. A relatively small number of fish are likely to be adversely affected by these activities and the agents associated with them. Fish populations in the planning area are not expected to experience any irreversible and irretrievable effects associated with Alternative E.

8. Birds: Loss or degradation of an insignificant proportion of available habitat as a result of pad, road, and pipeline construction and gravel extraction during development may be irreversible. Although some proportion of habitat alteration is expected to be permanent, such areas may be partially reclaimed at the conclusion of activities using techniques developed in recent years.

Table IV.J-1
Resource Estimates by Alternative: First and Multiple Sales

	First Sale		Multiple Sales	
	Estimated Range (MMbbl)		Estimated Range (MMbbl)	
Alternative	price/barrel $18	price/barrel $30	price/barrel $18	price/barrel $30
B	65	350	90	500
C	75	410	110	580
D	185	825	370	1,650
E	250	1,100	500	2,200

9. Mammals:

a. Terrestrial Mammals: It is possible that caribou and other terrestrial mammals could be subjected to direct and indirect effects of disturbance due to noise and movement of motor vehicles, aircraft, and other human activities, oil spills, or losses and/or deterioration of habitat due to facility developments. It is likely that such effects would lead to some permanent (irreversible) losses of these resources (Sec. IV.C.9.a).

b. Marine Mammals: It is possible that seals, walruses, polar bears, and belukha whales could be subjected to direct and indirect effects of oil spills, disturbance due to noise and movement of aircraft and vessels, and other human activities. It is unlikely that such effects would lead to permanent (irreversible) losses of these resources (Sec. IV.C.9.b).

10. Endangered and Threatened Species: It is possible that bowhead whales could be subjected to direct and indirect effects of disturbance due to noise from vessel traffic. It is unlikely that such effects would lead to permanent (irreversible) losses of these resources for bowhead whales.

It also is possible that spectacled eiders and Steller's eiders could be subjected to direct and indirect effects of disturbance due to noise and movement of aircraft and vessels and other human activities, or loss and/or deterioration of habitat due to facility siting. Facility siting could result in permanent (irreversible) loss of an insignificant proportion of available eider-nesting habitat. Although it is unlikely that the other effects would result in irretrievable loss of these resources, recovery of the eider populations from any substantial mortality is not expected to occur while they are declining.

11. Economy: The commitment of human resources would be irreversible and irretrievable. That is, routine activity would generate employment at an enclave near the Prudhoe Bay complex for workers who would reside permanently in Southcentral Alaska. Also, there would be an increase in resident employment and population in the NSB.

12. Cultural Resources: Cultural resources are nonrenewable. Once a cultural resource locale is physically impacted, it cannot be reclaimed.

13. Subsistence-Harvest Patterns: Many important aspects of Inupiat society and culture are centered around subsistence activities (Sec. III.C.2). Virtually every family on the North Slope participates in the hunting of the bowhead whale and the sharing of its meat. The activities associated with the taking of caribou, seals, fish, and birds are somewhat less important to the integration of the region as a whole (but certainly not in the inland village of Atqasuk), but they are of equal importance to the social organization of each community as well as to the domestic economies of most households. As with the bowhead whale, the inability to harvest sufficient quantities of these resources would be an irreversible and irretrievable loss to the Inupiat diet, to Inupiat traditional practices of sharing and reciprocity, and to fundamental aspects of Inupiat identity.

14. Sociocultural Systems: Disruption to the traditional harvest of caribou, especially in Nuiqsut, could be an irreversible and irretrievable loss to Inupiat social and cultural values. The contribution of oil and gas development in the planning area to the cumulative consequences of offshore and onshore energy development could, in conjunction with other processes of social change in the long term, lead to the irretrievable loss of Inupiat cultural behaviors and traditional practices.

15. Recreation and Visual Resources: Given time, there would be no irreversible and irretrievable commitment of resources. Conducting proper rehabilitation and removal of development pads, etc. should restore the perception of a natural environment.

K. EFFECTS OF NATURAL GAS DEVELOPMENT AND PRODUCTION:

Natural gas may be discovered in the Northeast NPR-A Planning Area during exploration drilling. Although gas resources are not considered economic to exploit at this time or in the foreseeable future (Sec. IV.A.1.b(1)(b)), they could be developed and produced at some undetermined future time. Under such circumstances, natural gas production probably would not occur until after oil production had begun. Thus, leases containing nonassociated natural gas that could be recoverable in the future probably would be retained by the leaseholder. (Associated and dissolved gases that are recovered along with the crude oil are expected to be reinjected or used as fuel, depending on the amount recovered.) The effects of potential gas development and production on the environment of the planning and adjacent areas that would be additional to the effects associated with oil development and production are described in this section.

Additional facilities and infrastructure would be needed if and when the nonassociated natural gas is developed and produced. The gas could be produced through wells drilled from gas-production platforms.

A large-diameter pipeline would be installed to transport the produced gas from the production pad(s) to a gas-processing facility located in the Prudhoe Bay area; the gas pipeline would be separated from any oil pipelines to the extent necessary to minimize the risks that would arise during installation and operation; however, the main trunk gas pipeline would be constructed parallel to the trunk oil pipeline. No booster-pump stations would be required between the production pad(s) and the gas facility.

After processing, the gas would be piped to Valdez for liquefaction. The required gas pipeline would parallel the TAPS. The liquefied gas would be shipped to market, most likely in Asia. However, should a regassification plant be constructed on the U.S. West Coast, a market also could develop there.

Effects of natural gas development and production on the biological resources, social systems, and physical regimes of the planning area and adjacent areas could be caused by gas blowouts; drilling gas-production wells; installing onshore pipelines and a gas-processing facility; surface- and air-traffic noise and disturbance; construction activities; and growth in the economy, population, and employment.

Accidental emissions of natural gas could result from a gas-well blowout or a pipeline rupture. In the unlikely case that such an event occurred, a gas-well blowout probably would not persist for >1 day and would release perhaps 20 metric tons of gaseous hydrocarbons; 60 percent of all blowouts since 1974 have lasted ≤1 day. From such a blowout, a hazardous plume of gas could extend downwind for about a kilometer but quickly would dissipate once the blowout ceased. The amount of volatile organic compounds released by such a blowout would be less than that evaporated from an oil spill >1,000 bbl.

The rupture of a gas pipeline would result in a short-term release of gas. A sudden decrease in gas pressure automatically would initiate procedures to close those valves that would isolate the ruptured section of the pipeline and thus prevent a further escape of gas.

Following are analyses of the effects of natural gas development on:

1. Soils:

The types of impacts on soils that natural gas development and production would cause would be the same as those caused by oil development and described in Alternatives B through E, except that there would be no crude oil spill. Spills of refined oil still would occur. Thus, additional development of material sites, burial under gravel fill for production and facilities pads, roads and airstrips, and construction of pipelines would cause the destruction of additional soils in the planning area.

2. Paleontological Resources:

Natural gas development is similar to the production of oil, and they generally occur together. The infrastructure necessary to produce oil basically is the same to produce gas. Therefore, the impacts accountable for the production of gas would be the same as those discussed for oil.

3. Water Resources:

The adverse effects of gas exploration and development on water resources would be similar to the effect of oil exploration and development. The main difference would be the lack of spills and cleanup, because a natural gas blowout would be released to the air and not to streams or lakes.

4. Water Quality:

The risk to water quality from gas accidents during natural gas development, production, and transportation would be less than the risk from oil spills from oil development, production, and transportation. Degradation of water quality related to seismic and gas exploration and to construction, placement, and operation of gas-production facilities would be the same as those for exploration and oil production. Tanker oil spills would not occur.

5. Air Quality:

The risk to air quality from natural gas development, production, and transportation would be similar to the risk from oil development, production, and transportation. Degradation of air quality related to construction, placement, and operation of gas exploration and production facilities would be the same as those for oil exploration and production facilities.

6. Vegetation: The types of effects on vegetation that natural gas development and production would cause would be the same as those caused by oil development and described in Alternatives B through E, except that there would be no crude-oil spill. Spills of refined oil still would occur. Thus, development of material sites, burial under gravel fill for production and facilities pads, roads and airstrips, and construction of pipelines would cause the destruction of additional vegetation in the planning area, given that pads additional to those constructed for oil development would be needed. Plant-species-composition change also would occur in areas adjacent to pads and pipeline VSM's.

7. Fish: Natural gas exploration and development could adversely affect arctic fish due to either a natural gas blowout or the construction of overland gas pipelines. If a natural gas blowout occurred, some fish in the immediate vicinity might be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. A plume of natural gas vapors and condensates would be dispersed very rapidly from the blowout site, but it is not expected to be hazardous for >1 km downwind or for >1 day. The construction of overland gas pipelines through waters supporting fish populations is expected to have short-term effects on fish and would displace those affected a short distance. However, those affected are expected to reuse their habitat upon completion of activities.

8. Birds: Any effects of natural gas development and production on birds, such as noise and visual disturbance from vehicles or construction activity, are expected to be temporary, nonlethal, and local, affecting a few individuals. However, a natural gas blowout occurring from May to October could affect birds that are nesting, rearing young, staging, or migrating. Some mortality could result from such an incident, although it is likely that a small number of individuals would be affected.

9. Mammals:

a. Terrestrial Mammals: The most likely effects of natural gas development and production in the planning area on caribou and other terrestrial mammals would come from motor-vehicle traffic and construction activities associated with installing the onshore pipeline system that connects the production pads with the onshore processing facilities. Onshore, the gas pipelines would run parallel to the oil pipeline and would be serviced by the same infield roads. Road-traffic disturbance of caribou along the gas-pipeline routes would be most intense during the construction period, when motor-vehicle traffic is highest, but would subside after construction is complete. Some displacement of calving caribou would be expected within 3 to 4 km of roads between oilfield facilities when they are located within caribou calving habitat. Caribou are likely to successfully cross the pipeline corridor within a short period of time (perhaps within a few hours or no more than a few days) during breaks in the traffic, with little or no restrictions in general movements and no effect on overall caribou distribution and abundance. As with construction of the oil pipeline, the construction of the gas pipeline would alter only a small fraction of caribou and other terrestrial mammal range.

If a gas blowout occurred, the toxic plume likely would extend downwind about 1 mi, dissipate quickly, and last for not much more than 1 day. If there were an explosion and fire, the wet tundra habitat of most of the Arctic Slope likely would not catch fire and spread to other areas. However, if a gas blowout occurred in the Umiat area, a tundra fire may spread to other areas, but the gas plume itself is likely to persist for no more than 1 day. The effect on terrestrial mammals and their habitats likely would be local and short term.

b. Marine Mammals: The most likely effect of natural gas development and production in the planning area on seals, walruses, polar bears, and belukha whales would come from air traffic that may occur along the coast to and from the exploration and development facilities in the planning area and support facilities at Prudhoe Bay and Camp Lonely. The air traffic associated with gas production would be an additive source of noise and disturbance of marine mammals. However, the effect of this noise and disturbance likely would be very brief and result in only a temporary displacement of some marine mammals along the flight paths (a short-term effect).

10. Endangered and Threatened Species: Should natural gas development and production occur in the planning area, it is unlikely that bowhead whales would be affected. If materials and supplies are transported to the planning area, by marine vessels during the fall bowhead whale migration, some whales could experience temporary, nonlethal effects as described under Alternative B.

Any effects of natural gas development and production on spectacled and Steller's eiders also are expected to be limited to temporary, nonlethal effects, perhaps resulting in disturbance to a few birds. However, a natural gas blowout occurring from June to September could affect eiders that are nesting, rearing young, staging, or migrating. Some mortality could result from such an incident, although it is likely that a small number of individuals would be affected.

11. Economy: Natural gas development and production from the NPR-A, especially construction of a gas pipeline from the NPR-A through Prudhoe Bay to Valdez, would generate additional employment. The employment would be in the workers' enclave in the Prudhoe Bay complex and temporary work camps along the gas pipeline. Most workers would reside in Southcentral Alaska. A small number of workers would reside in the NSB. Development would generate additional property-tax revenues for the NSB and property tax, royalties, and severance tax for the State.

12. Cultural Resources: Natural gas development is similar to the production of oil, and they generally occur together. The infrastructure necessary to produce oil basically is the same to produce gas.

13. Subsistence-Harvest Patterns: Effects on subsistence-harvest patterns from natural gas development and production could occur from natural gas blowouts, noise and traffic disturbance, and construction activities. If a natural gas blowout occurred, the subsistence harvest of any species in the vicinity could be affected. Additionally, if a natural gas blowout occurred, with possible explosion and fire, subsistence resources in the immediate vicinity probably would be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. However, natural gas vapors and condensates would be dispersed very rapidly from the blowout site (1 km downwind for about 1 day) and would affect only those species in the immediate vicinity of the accident. While such an effect would be relatively short term and localized and likely would not measurably affect the regional population of any species, it could cause disruption to subsistence harvests in the area of the blowout. Noise and disturbance activities due to the development of a gasfield, especially to caribou, would be local (within 3-4 km of the pipeline corridor) but would persist for the life of the field.

14. Sociocultural Systems: Effects on sociocultural systems would be due to changes in employment and population and effects on subsistence-harvest patterns. In the event of natural gas development and production in the planning area, there would be a slight increase in employment and population in the region adjacent to the planning area.

15. Coastal Zone Management: Natural gas development and production are assumed to occur in the NPR-A. Conflicts with specific Statewide standards and NSB CMP policies are related to potential user conflicts between natural gas development and production activities and effects from contruction and transportation on the natural resources and subsistence -harvest patterns and activities if a natural gas blowout occurred. Potential effects to biological resources and habitats are analyzed in Sections IV.4.K.1-14. Although effects from these activities is expected to be local and short-term, potential effects from pipeline construction is possible. Therefore, some level of conflict from natural gas development with coastal management programs is anticipated.

16. Recreation and Visual Resources: Natural gas development is similar to the production of oil, and they generally occur together. The infrastructure necessary to produce oil basically is the same to produce gas. Therefore, the impacts accountable for the production of gas would be the same as those discussed for oil.

BLANK PAGE

L. EFFECTS OF A LOW-PROBABILITY, HIGH EFFECTS, OIL-SPILL EVENT:

An oil spill is the single event with the greatest potential impact to the environment during exploration and development. An Oil Spill Contingency Plan is required prior to approval and conduct of any drilling activity to address the protection of waters and landforms and meet impacts produced as a consequence of accidental spills.

In the Introduction and Basic Assumptions for Effects Assessment section (Sec. IV.A) of this document is a section on oil spills. Based on data obtained on the history of spills on the North Slope, estimates are made as to the number, types, and quantity of spilled crude and refined oil that can be anticipated under the various alternatives. The environmental consequences of these estimates are contained in the discussions by resource throughout the remainder of Section IV.

The purpose of this section is to provide scenarios for low-probability, high-effects, oil-spill events. Two hypothetical cases are considered in this section: a well blowout; and an oil-pipeline rupture. A third hypothetical tanker spill case is considered in Appendix B.

Well Blowout: *The Alpine Development Project: Environmental Evaluation Document* (September 1997 Revision), prepared for the U.S. Army Corps of Engineers by Arco Alaska, Inc. et al., identified a well blowout as the "reasonable worst-case" oil spill. In that document, it was estimated that the spill would amount to 1,000 bbl/day. It also was stated that typically a blowout would be controlled within 3 days using heavy muds or other "top kill" intervention.

For purposes of analysis in this IAP/EIS, it was assumed that a relief well would need to be drilled, and that the onsite drill rig would be damaged. For this scenario, an estimated 34 days could elapse prior to controlling the well. An estimated 34,000 bbl of crude oil would spill. If such an event were to occur during exploration, oil from the plume fallout and the wellhead would be deposited over snow and ice surfaces. If such an event occurred during the drilling of a development well, it still is likely that the oil would be deposited over snow and ice surfaces, because those are the prevailing conditions the majority of the year on the North Slope. However, the event could occur during spring breakup or during the summer season and deposit the oil on melting snow and ice or water and vegetation, respectively.

The area affected would be determined by the plume size, which is dictated by flow pressure and the diameter of the orifice. Typically, >30 percent of the oil evaporates before settling on land. For this scenario, it is projected that oil droplets settling out from the plume could cover up to several acres in downwind directions. Also, oil flowing from the drill site would spread downslope following the terrain and potentially flow into a lake or waterbody. The estimated area of impact is ≤150 acres.

For a discussion of the Fate and Behavior of Oil Spills, please refer to Section IV.A.3. Given the present technology associated with blowout prevention and effective well control, it is extremely unlikely that an uncontrolled release of crude oil could occur.

Pipeline Rupture: A pipeline rupture is identified as the "extreme worst-case" in *The Alpine Development Project: Environmental Evaluation Document* (September 1997 Revision). For purposes of this IAP/EIS, it was assumed that a 14-in diameter pipeline with a flow rate of 48/bbl/minute ruptures with an initial discharge of 50 bbl. The 2,800 bbl of oil contained within the pipeline is assumed to be released due to the distance and gradient to the shutoff valves.

Oil flowing from the pipeline rupture would spread downslope following the terrain and potentially could flow into a lake or waterbody. While the highest probability is that the oil would be deposited on a snow and ice surface, it could be deposited on melting snow, ice, and water, or on vegetation, depending on the time of the year. The estimated area of impact is ≤150 acres.

1. Soils:

Impacts on soils are closely related to surface activities and disturbance on the vegetative cover. In the case of oil spills, the greatest potential for impact is related to cleanup activities. If activities occur during times of the year when there is adequate protection to the vegetative cover for snow and ice, and the tundra is frozen, there would be no impacts to soils. If activities occurred during the summer season, impacts from cleanup activities would include compaction from trampling and the movement of supplies and personnel. Surface disturbance would be minimized by using standard cleanup procedures such as flooding, use of skimmers, use of boardwalks, and transportation of cleanup crews by low-ground pressure-wheeled vehicles (rolligons). Potentially, an area of 150 acres could be impacted, depending on the extent and severity of disturbance to the vegetation.

2. Paleontological Resources:

Paleontological resource usually are so deeply buried that they would not be affected by either a spill or cleanup.

3. Water Resources:

Spill cleanup in the watershed would involve containing the spill, diverting or isolating it within the waterbody, skimming off the oil, and treating the remaining oil-contaminated water and sediments. Prevention and rapid response with adequate removal equipment would minimize effects.

For spills during frozen conditions, it is anticipated that oil would not reach open water. Following contaminated snow and ice removal, water-quality impacts from the residual oil would be very limited in extent and duration.

For spills during breakup conditions or the summer season, oil-spill response likely would recover the bulk of spilled oil. Sufficient oil could remain to promote lethal and sublethal toxicity levels for approximately 7 years and negative aesthetic impacts of a visible oil sheen and oil residues. In addition, equipment used to contain and recover spilled oil likely would damage the tundra surface, potentially leading to thermal and hydraulic erosion, causing local water-quality degradation.

4. Water Quality: For spills during frozen conditions, it is anticipated that oil would not reach open water. Following contaminated snow and ice removal, water-quality impacts from the residual oil would be very limited in extent. However, even small quantities of oil remaining after cleanup could result in lethal and sublethal toxiciy levels in waters within the spill area for approximately 7 years.

During summer, flat coastal tundra develops a dead-storage capacity averaging 0.5 to 2.3 in (Miller, Prentki, and Barsdate, 1980), which would retain 300 to 1,500 bbl of oil per acre. Even at high-water levels, the tundra vegetation tends to act as a boom and vegetation and peat as a sorbent, allowing water to filter through, trapping the more viscous oil (e.g., Barsdate et al., 1980) and also making recovery of the oil more difficult. On the other hand, even small spill spills can be spread over large areas, if the spill event includes aerial, pressured discharge. For example, in December 1993, ARCO Drill Site line failed and 1 to 4 bbl of crude oil misted over an estimated 100 to 145 acres (Ott, 1997). For a large spill during breakup conditions or the summer season, oil-spill response likely would recover the bulk of spilled oil. However, sufficient oil could remain to result in lethal and sublethal toxicity levels in waters within the spill area for approximately 7 years. In addition, equipment used to contain and recover spilled oil likely could damage the tundra surface, potentially leading to thermokarst erosion causing local water-quality degradation.

5. Air Quality: The primary sources of pollutants would be volatile gases from the oil and exhaust emission from cleanup equipment. Impacts would be temporary and localized at the site of the spill. It is anticipated that no cases would result in an exceedance of Federal and Alaska State air-quality standards. It is assumed that cleanup would not include burning the oil.

6. Vegetation: Because winter spans the majority each year, most spills happen when there is sufficient snow cover that cleanup efforts occur before the oil reaches the vegetation; this situation occurs during about 60 percent of the year. Past spills on Alaska's North Slope have caused minor ecological damage, and ecosystems have shown a good potential for recover (Jorgenson, 1997). Spills would be cleaned up, causing minor ecological damage, and the ecosystems would be likely to recover in a few to 20 years. There is a potential for equipment used to contain and recover spilled oil to damage the tundra, potentially leading to thermal and hydraulic erosion.

7. Fish: Considered here are the likely effects of a of 34,000-bbl oil spill from a well blowout and a pipeline oil spill of 2,800 bbl. Each spill is estimated to affect ≤150 acres of terrain within the planning area. Lethal effects on fish due to spilled oil are seldom observed outside the laboratory environment. Sublethal effects are more likely and include changes in growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources; and consumption of contaminated prey. The specific effect of oil on fish generally depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved.

During frozen conditions, oil is not likely to enter a water body directly, and there would be sufficient time to remove the oil and contaminated snow and ice before spring break-up. However, oil spills could have a significant adverse effect on arctic fish if they entered overwintering areas (where fish are concentrated in winter), or fish bearing water bodies during the open-water period. Nevertheless, due to the thickness of winter ice, the probable distance between waterbodies-pipelines and well sites, and the low concentration of fish in most of the planning area, neither of these possibilities are considered likely. Hence, any oil reaching a body of water at anytime of the year is expected to have only sublethal effects on a small number of fish. While these sublethal effects could require up to 3 years for full recovery of the affected area, no significant effects on arctic fish populations are expected.

8. Birds: Only a spill occurring during the summer season and entering aquatic habitats is likely to directly impact substantial numbers of birds, primarily migratory waterfowl. Effects on birds would be the same as described in Sec. IV.C. Lethal effects are expected to result from moderate to heavy oiling of any birds contacted. Light to moderate exposure could reduce reproductive success, either through lethal contamination of eggs by oil transferred from incubating adults, or pathological effects, caused by oil ingested by adults during preening or feeding, interfering with the reproductive process. In addition, oil in tundra ponds can have long term effects on invertebrate prey populations and emergent vegetation thereby reducing food availability and escape cover for waterbirds in the area impacted by the spill. The greatest potential for mortality could result from a spill entering one or more of the primary goose molting lakes during molting season (late June- mid August). Because many of these lakes may be occupied by a substantial molting waterfowl population, thousands of individuals could be affected. Oiling of nonaquatic habitats could result in mortality of additional hundreds, potentially thousands, of shorebirds and some passerines and would be expected to render the affected area essentially uninhabitable for a substantial interval. A spill during a winter when substantial snowcover is present is not expected to cause significant adverse effects because most birds are absent from the area, and the potential for thorough cleanup, and thus for minimal secondary contamination following snowmelt, is high.

Disturbance caused by oil spill containment and cleanup operations involving human presence, ground traffic, and air traffic for extended periods also could adversely influence reproductive success of breeders and survival of molting birds. Depending on the season, birds may be displaced from preferred nesting habitat, may incur additional nest predation if displaced periodically from an active nest site, or may be displaced from preferred foraging habitat when metabolic demands of molt require efficient energy uptake.

9. Mammals:

a. Terrestrial Mammals: Assuming a well blowout of 34,000 bbl and/or a pipeline spill of 2,800 bbl occurred onshore, these spills are expected to have some effects on caribou and other terrestrial mammals in the planning area. For a discussion of potential effects to terrestrial mammals, refer to Sec.IV.G.9.a. Caribou, moose, and muskoxen may become oiled or may ingest contaminated vegetation. Oil ingestion could result in anorexia (significant weight loss) and aspiration pneumonia, leading to the death of affected mammals. Caribou and other terrestrial mammals that become oiled by contact with these spills if the spills contaminated lakes, ponds, rivers, or coastal waters could die from toxic-hydrocarbon inhalation and absorption through the skin. The blowout and pipeline spills could result in the loss of small numbers of grizzly bears, wolverines, and wolves through ingestion of contaminated prey or carrion near the spill sites. However, such losses are not expected to be significant to the populations on the Arctic Slope.

The 34,000-bbl blowout spill and 2,800-bbl pipeline spill are assumed to contaminate ≤150 acres of tundra vegetation near the spill sites. It is likely that control and cleanup operations (ground traffic, air traffic, and personnel) at the spill site would frighten caribou and other terrestrial mammals away from the spill, reducing the number of individuals exposed to the spills. The contamination of ≤150 acres of tundra habitat near the spill sites would not be expected to significantly contaminate or alter caribou or other terrestrial mammal habitats. If one or both of these two spills contaminated a stream, the affect on foraging habitat would occur over areas larger than 150 acres.

b. Marine Mammals: Assuming a well blowout of 34,000 bbl and/or a pipeline spill of 2,800 bbl occurred onshore, these spills are expected to have little effect on seals, walruses, and polar bears. For a discussion of potential effects to marine mammals, refer to Sec.IV.G.9.b. If some of the oil contaminated streams in the Teshekpuk Lake area that drain into marine waters, small numbers of seals, polar bears, and other marine mammals might be exposed to contamination in nearshore habitats and suffer lethal or sublethal effects. A small number of breeding ringed seals and their pups could be contaminated by either of these spills that reach the marine environment during early winter, resulting perhaps in the death of some pups (perhaps 10-30 animals, because of the relatively small size of these spills and the sparse distribution of pupping lairs). Even smaller numbers of polar bears, walruses, and belukha whales are expected to be exposed to and affected by these small spills.

10. Endangered and Threatened Species:

It is not likely that bowhead whales would be affected by oil spilled from either a well blowout or a pipeline rupture, because both their spring and fall migration occurs well offshore from the Colville River delta. The Colville River would be the most likely route for oil to reach the marine environment in quantities large enough to be a threat to bowhead whales. Most, if not all, of the spilled oil likely would be contained on land. The estimated area of impact is ≤150 acres. Effects on the spectacled and Steller's eiders would be the same as those described previously under Alternative E. If the spill occurs during the summer months and reaches a body of water in an area used by eiders for nesting and rearing broods, some eiders could be affected by the spill. Some eiders could experience sublethal effects from ingestion of oil from preening oiled feathers, and some mortality could occur as a result of eiders being exposed to spilled oil. The number of eiders affected is likely to be fairly small, because the density of eiders in the planning area is fairly low. Steller's eiders are less likely to be affected than spectacled eiders, because the planning area is not their primary Alaskan nesting area.

11. Economy:

Various entities might benefit economically from participation in the oil-spill-contingency planning process and oil-spill-response and -cleanup. No workers would be needed to clean up the oil spillage beyond those already employed in the workers' enclave.

12. Cultural Resources: The actual spilling of hydrocarbons on a cultural resources site would, in most cases, have limited impact, especially if the spill occurs when the ground is covered with snow and frozen. However, spill cleanup may pose a serious threat to the integrity of a site, perhaps resulting in its destruction.

13. Subsistence-Harvest Patterns: Potential oil spills from a 34,000-bbl blowout spill and a 2,800-bbl pipeline spill potentially could affect a total of 300 acres. Depending on the season, the oil could be deposited over snow and ice or over water and vegetation. The blowout event would be contained in 3 days. For the pipeline spill, oil would spread downslope, potentially flowing onto snow and ice in winter or into lakes or other bodies of water in summer.

Oil spills occurring during the winter season could affect sealing and polar bear hunting. In spring, whaling, sealing, and bird hunting could be affected. In the open-water season, whaling, sealing, walrus hunting, and bird hunting could be impacted. If the waterbody contaminated by a spill were the Colville River, a spill entering the river potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would affect substantially the subsistence harvest. Onshore spills are unlikely to reach the marine environment, but if spilled oil did reach the marine environment, it likely would be a very small amount and any exposure to spilled oil likely would not pose serious direct effects to bowhead whales and marine mammals. But if any perceived disruption of the bowhead whale harvest from oil spills and any tainting or perceived tainting anywhere during the bowhead immigration, summer feeding, and outmigration could disrupt the bowhead hunt for an entire season, even though whales would not be rendered unavailable.

Biological effects to subsistence resources might not necessarily affect species distributions or populations, but disturbance could extend the subsistence hunt, making more frequent and longer trips necessary to harvest enough resources in a given harvest season. Waterfowl population loss from oil spills could cause harvest disruptions that would be significant to subsistence hunters who regard the spring waterfowl hunt to be of primary importance. In the event of a large spill contacting and extensively oiling habitats, the presence of hundreds of humans, boats, and aircraft would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters.

14. Sociocultural Systems: Effects to sociocultural systems from blowout and pipeline spill events are expected to occur as a result of effects to subsistence resources, subsistence practices, and disturbance from oil-spill cleanup. During the winter season, sealing and polar bear hunting could be affected. In spring, whaling, sealing, and bird hunting could be affected. In the open-water season, whaling, sealing, walrus hunting, and bird hunting could be impacted.

Potential oil spills from a 34,000-bbl blowout spill and a 2,800-bbl pipeline spill potentially could affect a total of 300 acres. Depending on the season, the oil could be deposited over snow and ice or over water and vegetation. The blowout event would be contained in 3 days. For the pipeline spill, oil would spread downslope, potentially flowing onto snow and ice in winter or into lakes or other waterbodies in summer. If the waterbody contaminated by a spill were the Colville River, a spill entering the river potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would affect substantially the subsistence harvest. Onshore spills are unlikely to reach the marine environment, but if spilled oil did reach the marine environment, it likely would be a very small amount and any exposure to spilled oil likely would not pose serious direct effects to bowhead whales and marine mammals. But if any perceived disruption of the bowhead whale harvest from oil spills and any tainting or perceived tainting anywhere during the bowhead immigration, summer feeding, and outmigration could disrupt the bowhead hunt for an entire season, even though whales would not be rendered unavailable.

Biological effects to subsistence resources might not necessarily affect species distributions or populations, but disturbance could extend the subsistence hunt, making more frequent and longer trips necessary to harvest enough resources in a given harvest season. In the event of a large spill contacting and extensively oiling habitats, the presence of hundreds of humans, boats, and aircraft present for oil-spill cleanup activities would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters.

15. Coastal Zone Management: Potential oil spills from a 34,000-bbl blowout spill and a 2,800-bbl pipeline spill potentially could affect a total of 300 acres. Depending on the season, the oil could be deposited over snow and ice or over water and vegetation. A blowout event would be contained in 3 days. For the pipeline spill, oil would spread downslope, potentially flowing onto snow and ice in winter or into lakes or other water bodies in summer.

The policies that were relevant for Alternatives B through E remain relevant for this analysis. Potential conflicts could occur with policies related to the potential for user conflicts from a pipeline spill or blow-out effects related to adverse effects on subsistence resources. These effects would occur in the event of spilled oil contacting subsistence resources and habitats, and the activities associated with oil-spill cleanup. Potential conflict with the subsistence; habitat; and air, land, and water quality standards of the ACMP and NSB CMP district policies may occur.

16. Recreation and Visual Resources: The impacts to recreation and visual resources would be primarily related to negative impacts to aesthetic values associated with visible oil sheen and residues on vegetation and water.

518

SECTION V

RESERVED
FOR
FINAL EIS

REVIEW AND ANALYSIS
OF
COMMENTS RECEIVED

SECTION VI

CONSULTATION AND COORDINATION

VI. CONSULTATION AND COORDINATION

A. INTRODUCTION: Management of public lands on Alaska's North Slope, including the Northeast NPR-A Planning Area, is of considerable public interest, not just within the State of Alaska, but throughout the Nation. Expertise on the resources of the planning area is also widely dispersed. People knowledgeable about the resources are found in many agencies of the Federal, State, and North Slope Borough (NSB) governments and in academia, environmental interest and study groups, industry, and the people who call the North Slope home.

The BLM has reached out to all these groups to obtain information on the issues and the resources of the planning area. The following discussion begins by summarizing this effort focusing on five elements: our formal "scoping" work, a series of workshops and meetings held to pool resource information and develop ideas for future management, multiple reviews of drafts of parts of the IAP/EIS, special cooperative arrangements with the State and the NSB, and publications that have kept the public informed of our progress. The section then concludes with a brief description of the groups contacted during the planning process and a list of the BLM and MMS authors of the plan.

B. FORMAL SCOPING: The formal scoping period began when BLM published a Notice of Intent (NOI) to prepare the Northeast NPR-A IAP/EIS in the *Federal Register* on February 13, 1997. This initiated a 30-day public scoping period. Scoping comments also were requested through the NPR-A internet web site (http://aurora.ak.blm.gov/npra/); comment sheets distributed at public meetings; advertisements in the *Anchorage Daily News*, *Arctic Sounder*, and Fairbanks Daily News-Miner;, announcements on KBRW public radio (Barrow); and the *npr-a report*, a newsletter distributed by the BLM-Alaska Office of External Affairs. (The newsletter has since been renamed the *npr-a update*.) These announcements requested public comment on the wide range of resources of the planning area and for ideas on its future management. The NOI also included a call for nominations from the oil industry for lands within the planning area to be considered for oil and gas leasing.

During the formal scoping period, BLM met with a wide range of interested parties. This included representatives of environmental groups; the oil industry; North Slope village and corporate leaders; and leaders of NSB, State, and other Federal land-management and resource-protection agencies. Public meetings were held in Barrow, Atqasuk, Anchorage, Fairbanks, and Nuiqsut during March and April 1997. These meetings were facilitated and electronically recorded and subsequently transcribed into a written record. An interpreter was present at the meetings in the North Slope communities. More than 175 people attended those meetings, and 101 written comments were received during the scoping period. The formal public scoping period ended April 18, 1997, following an extension to accommodate scheduling conflicts that delayed the Nuiqsut public meeting.

C. WORKSHOPS AND MEETINGS: The BLM and the Minerals Management Service (MMS), which has helped BLM develop the IAP/EIS, have held four workshops or meetings to obtain information and/or develop alternatives. The first of these was the *NPR-A Symposium* held April 16-18, 1997, in Anchorage. It was convened to provide BLM and MMS with the most current information on resources and their uses in the northeast planning area and the potential impacts that may incur from various land use activities. More than two dozen speakers from government agencies, academia, industry, and private consulting companies gave presentations during the three-day symposium, which was attended by more than 130 people. A synopsis of the sessions was published in the *NPR-A Symposium Proceedings: Science, Traditional Knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve-Alaska* (MMS, 1997).

The following week, BLM held a *planning meeting* with representatives from MMS, the Fish and Wildlife Service (FWS), Alaska Department of Natural Resources, Alaska Department of Fish and Game, and the NSB to review the scoping issues and formulate management alternatives. The first preliminary draft of the alternatives resulted from this meeting.

The *Teshekpuk Lake Waterfowl/Caribou Impact Analysis Workshop* was held May 21-22, 1997, in Fairbanks to provide BLM with specific guidance for developing maximum protective measures for waterfowl and caribou in the Teshekpuk Lake area under an alternative that would allow for economically feasible oil and gas leasing in that area. On the first day, academic, industry and other nonagency biologists and other specialists presented pertinent background information. On the second day, there was one panel each for caribou and waterfowl. These panels consisted of Federal, State, and Borough government representatives with expert knowledge of waterfowl and caribou biology and wildlife interactions with North Slope oil- and gasfield operations. The FWS provided invaluable GIS data on waterfowl. A summary of these proceedings can be found in Appendix E.

An *NPR-A Subsistence Impact Analysis Workshop* was held August 19-21, 1997, in Nuiqsut to provide BLM with specific guidance on protective measures for subsistence resources and users under alternatives which would allow oil and gas leasing. A workshop panel consisted of Federal, State, Borough, and tribal government representatives from Barrow, Atqasuk, Nuiqsut, and Anaktuvuk Pass with both scientific and traditional knowledge of subsistence resources and their uses in the planning area. Public meetings were held in Nuiqsut and Barrow in conjunction with the subsistence workshop to solicit additional information from local residents for the panel's consideration. A summary of these proceedings are included in this document as Appendix F.

D. PEER REVIEWS: The BLM and MMS implemented a formal peer review process for the preliminary draft EIS that included specialists from the U.S. Geological Survey (including its Biological Resources Division), FWS, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, National Park Service, Bureau of Indian Affairs, U.S. Forest Service, National Weather Service, Natural Resources Conservation Service, Office of Environmental Policy and Compliance (USDOI), State of Alaska, and the NSB. The peer reviewers examined early drafts of Sections II, III, and IV and responded in writing with corrections and suggestions for changes. In addition authors and reviewers engaged in individual conversations before, during, and after the review to exchange information. Some sections were sent out for a second series of reviews. Prior to going to print, staff of the FWS, State, and NSB joined with those of BLM and MMS to review of the entire document. The comments at all stages of the review have been constructive and exceedingly helpful. The BLM and MMS, not the reviewers, though, remain responsible for the descriptions of the environment and the impacts of the alternatives, and only BLM is responsible for the range of alternatives.

E. STATE AND NSB COOPERATION: Early in the IAP/EIS process, BLM invited the State and the NSB to join with us in this planning effort. The Borough helped coordinate scoping meetings, the subsistence workshop, and other contacts on the North Slope, provided much of its unique GIS data and research reports, and regularly consulted with BLM's leadership on the plan. The BLM also funded a new State position to assure smooth communication of state concerns and information between its managers and resource specialists on the one hand and the BLM/MMS planning team on the other. The State's coordinator was based in BLM's offices in Anchorage and was integrated into the planning team.

F. PUBLICATIONS: The BLM has distributed four issues of the *npr-a update*. The first, published for the formal scoping period, introduced the plan and solicited comments. The second reported to the public on the issues raised during scoping. The third newsletter updated readers on the plan, including Secretary Babbitt's visit to the NPR-A and the North Slope. The fourth issue of the *npr-a update* announced the publication of this draft IAP/EIS and the public meetings to be held to obtain comments on it. In addition, the BLM has periodically updated its NPR-A internet web site initiated during formal scoping. The draft IAP/EIS also will be available over the Internet.

G. AGENCIES AND ORGANIZATIONS CONSULTED: The following agencies and organizations have been contacted during the planning process.

- Federal Agencies
    - U.S. Department of Agriculture
        - National Resources Conservation Service
        - U.S. Forest Service
    - U.S. Department of Commerce
        - National Marine Fisheries Service
        - National Weather Service
    - U.S. Department of Defense
        - U.S. Army, Corps of Engineers
    - U.S. Department of Energy
    - U.S. Department of the Interior
        - Fish and Wildlife Service
        - Minerals Management Service
        - National Park Service
        - U.S. Geological Survey
    - U.S. Environmental Protection Agency

- State of Alaska Agencies and Commissions
    - Department of Fish and Game
    - Department of Natural Resources
    - Department of Regional and Community Affairs
    - Department of Transportation/Public Facilities
    - Division of Governmental Coordination

- University of Alaska, Institute of Social and Economic Research
- University of Alaska, Natural Heritage Program

Municipal Governments
- North Slope Borough
  - City of Anaktuvuk Pass
  - City of Atqasuk
  - City of Barrow
  - City of Kaktovik
  - City of Nuiqsut
  - City of Wainwright

Native Alaska Organizations
- Alaska Eskimo Whaling Commission
- Alaska Federation of Natives
- Arctic Slope Native Association
- Arctic Slope Regional Corporation
- Atqasuk Inupiat Corporation
- Barrow Whaling Captains Association
- Inupiat Community of the Arctic Slope
- Native Village of Atqasuk
- Native Village of Barrow
- Native Village of Nuiqsut
- Kuukpik Corporation
- Ukpeagvik Inupiat Corporation

Following is a partial list of other organizations (for a complete mailing list, contact:
Bureau of Land Management, Office of External Affairs (912), 222 W. 7th Ave., Anchorage, AK 99513)

Alaska Center for the Environment
Alaska Miners Association
Alaska Oil and Gas Association
Alaska Outdoor Council
Alaska Visitors Association
Alaska Wildlife Alliance
Alyeska Pipeline Service Company
Anardarko Petroleum Corporation
ARCO Alaska
BP Exploration
Chevron USA
Cominco Alaska
Ducks Unlimited Inc.
Exxon
Greenpeace
National Audubon Society
Northern Alaska Environmental Center
Phillips Petroleum
Sierra Club
The Nature Conservancy
Trustees for Alaska
Union Oil Company
Union Texas Petroleum Company
Wilderness Society
Elected Officials
- U.S. Senator Ted Stevens
- U.S. Senator Frank Murkowski
- U.S. Representative Don Young
- Governor of Alaska Tony Knowles
- Alaska State Senators
- Alaska State Representatives

H. LIST OF PREPARERS: The portions of Sections III and IV written by the following specialists are indicated in parentheses. ADO=Anchorage District Office, ASO=Alaska State Office, NDO=Northern District Office

Elinore M. Anker, MMS, Technical Publications Writer-Editor
Stan Ashmore, MMS, Cartographer
Dave Bieganski, BLM-ASO, Cartographic Technician
Bob Brock, MMS, Special Assistant to the Regional Director
Mike Burwell, MMS, Socioeconomic Specialist (Subsistence and Sociocultural Systems)
Phyllis Casey, MMS, Social Science Analyst (Coastal Zone Management)
Jim Craig, MMS, Geologist, (Petroleum Geology, Oil and Gas Assessment and Oil and Gas Exploration and Development ctivities)
Ida DeBock, MMS, GIS Technician
Roger Delaney, BLM-NDO, Natural Resource Specialist (Recreation and Visual Resources)
Jim Ducker, BLM-ASO, Plan Coordinator
Joe Dygas, BLM-ADO, Petroleum Geologist
Ray Emerson, MMS, Supervisory Environmental Specialist
Bob Fisk, BLM-ASO, Mining/Petroleum Engineer (Spill Prevention and Response)
Susan Flora, BLM-NDO, Environmental Scientist (Hazardous Materials)
Tim Hammond, BLM-NDO, GIS Specialist
Don Hansen, MMS, Wildlife Biologist, (Terrestrial and Marine Mammals)
Tim Holder, MMS, Economist (Economy)
Ken Holland, MMS, Marine Biologist (Fish)
Dwight Hovland, BLM-ASO, Soils Scientist (Soils)
Joel Hubbard, MMS, Wildlife Biologist (Birds)
Elliot Lowe, BLM-NDO, Natural Resource Specialist
Bob Karlen, BLM-NDO, Fisheries Biologist
Mike Kleven, BLM-NDO, Natural Resource Specialist
Jon Kostohrys, BLM-NDO, Hydrologist (Water Resources)
Mike Kunz, BLM-NDO, Archaeologist (Cultural Resources and Paleontological Resources)
Jody Lindemann, MMS, Technical Publications Writer-Editor
Don Meares, BLM-NDO, Natural Resource Specialist (Physiography, Sand and Gravel, and Oil and Gas Exploration—Environmental Status)
Mark Meyer, BLM-ASO, Physical Scientist (Mineral Potential)

Kyle Monkelien, MMS, Petroleum Engineer (Air Quality)
Anne Morkill, BLM-NDO, Wildlife Biologist/Facilitator
Johanna Munson, State of Alaska, NPR-A Coordinator
Jerry Nordmann, BLM-NDO, Natural Resource Specialist
Mazelle O. Parker, MMS, EIS Specialist
Dick Prentki, MMS, Oceanographer, (Water Quality and Fate and Behavior of Oil Spills)
Dick Roberts, MMS, Oceanographer
Kirk Sherwood, MMS, Geologist (Petroleum Geology and Oil and Gas Assessment)
Caryn Smith, MMS, Oceanographer (Climate and Meteorology and Oil Spills)
Gene Terland, BLM-ASO, NPR-A Team Leader
John Tremont, MMS, Geographer (Transportation and Major Projects Considered in the Cumulative Case)
Gail Walsh, BLM-ASO, Cartographic Technician
Frank Wendling, MMS, Marine Biologist (Endangered and Threatened Species)
Curt Wilson, BLM-ASO, Planner/Environmental Coordinator
Mike Worley, BLM-NDO, Realty Specialist (Lands)
Dave Yokel, BLM-NDO, Wildlife Biologist (Special Areas and Special Management Zones and Vegetation)

APPENDICES

A Inventory and Monitoring

B Effects of a Low Probability, High-Effects Very Large Oil-Spill Event

C Endangered and Threatened Species Consultation

D Section 810 of ANILCA, Findings and Evaluations

E Proceedings of the Teshekpuk Lake Area Caribou/Waterfowl Impacts Analysis Workshop

F Northeast NPR-A Integrated Activity Plan EIS Subsistence Impact Analysis Workshop Proceedings

G Wild and Scenic Rivers — Management Objectives and Standards and Assessment Process

H Visual Resource Management

I The Inupiat People's History and Future with regard to the National Petroleum Reserve-Alaska (NPR-A) A 1997 Perspective from the North Slope Borough

APPENDIX A

Inventory
and
Monitoring

INVENTORY AND MONITORING

During the life of this plan, inventory and monitoring would be used as a management tool to determine the status of the various resources within the area, to ensure compliance with plan decisions, to measure the effectiveness of the decisions, to ensure compliance with stipulations that are attached to land use authorizations, and to evaluate the effectiveness of the stipulations at accomplishing the purposes for which they are required. A monitoring program to accomplish these purposes would be developed and implemented. The most attention would be given to those activities that have the highest potential for environmental impact and those that are the most controversial. The results of these monitoring activities would be produced in reports. Any monitoring program that is developed would be done in cooperation with the State of Alaska, Department of Fish and Game; the U.S. Department of the Interior, Fish and Wildlife Service; and the North Slope Borough (NSB), as appropriate.

The following discussion provides the primary objectives for and brief descriptions of the types of inventory and monitoring that could occur for the surface resources the Bureau of Land Management (BLM) manages within the planning area.

1. **Cultural:** Inventory and monitoring of cultural resources would be conducted primarily to ensure that all sites eligible for the National Register of Historic Places (National Register) and other significant sites are preserved. Traditional knowledge is an important factor in the identification and interpretation of these sites. Inventories related to development activities would focus on specific locations, while inventories related to building a database of known sites would focus on more general areas—usually those expected to contain the highest numbers of cultural resources, such as good viewpoints, river banks, and game-concentration points. After a site is discovered through inventory/survey, it is evaluated against criteria for nomination to the National Register to determine its level of significance. Many of these sites would be useful in research, education, and interpretation to preserve the cultural heritage of North Slope residents.

Local concern over the identification and protection of cultural and historic places was exemplified in the comments made by Mr. Leonard Lampe at the public scoping meeting held in Nuiqsut.

2. **Lands:** The primary objective of an inventory and monitoring program for lands is locating through survey and subsequently conveying the Native allotments and other entitlements that exist under the Alaska Native Claims Settlement Act. The second objective is establishing the location and ownership of existing structures, primarily cabins, within the planning area. This information will be used to evaluate potential conflicts between existing land uses and potential oil and gas exploration and development. This information will also be used in studies and efforts by the BLM, working with the NSB, to address those structures that are on Federal public lands without authorization from the BLM.

3. **Fish:** Inventory and monitoring of fish would establish baseline information of fish populations, when necessary. A cooperative effort between agencies and disciplines to establish an issue-based, long-term monitoring program would be undertaken for activities where oil and gas exploration and development occur. This would include monitoring the effectiveness of mitigating measures through limnological, biological, and physical habitat studies. Monitoring of public-participation recreational and subsistence fisheries would be done. See the subsistence discussion in paragraph 7 for a discussion of how fish and subsistence inventory and monitoring are related.

4. **Hazardous Materials:** The BLM would conduct and maintain an inventory of lands to identify currently unknown hazardous materials sites. Research would be conducted to identify locations of past spills or dumps. Record searches and interviews with local residents and government personnel would be conducted. During oil and gas exploration and development, BLM would monitor activities to ensure compliance with permit requirements.

5. **Paleontology:** Inventory and monitoring of paleontological resources would be conducted primarily to ensure that all significant sites are preserved. Inventories related to development activities

would focus on specific locations, while inventories related to building a database of known sites would focus on more general areas, usually those along the Colville and Ikpikpuk rivers where known concentrations of paleontological specimens exist. After a site is discovered through inventory/survey, it is evaluated to determine its level of importance. Many sites would be useful in research, education, and interpretation to preserve the cultural heritage of North Slope residents.

6. **Recreation:** Commercial recreational use will be monitored for adherence to permit stipulations. The BLM also will monitor general recreation use that may occur within the planning area and on the adjacent rivers and sites where BLM has management jurisdiction. Monitoring will focus on both the impacts of recreation on other surface resources and the effects of activities, such as oil and gas exploration and development, on recreational values. As part of the monitoring program, BLM may conduct visitor-use surveys to ascertain what issues or concerns users of the area have.

7. **Subsistence:** Inventory and monitoring would assist in accomplishing the goal of conserving healthy populations of fish and wildlife resources that are important for subsistence purposes. Inventory-based data would be collected for caribou, moose, fish, furbearers, and various waterfowl. Incidental sightings of muskoxen and grizzly bears would provide data on these species. Of primary interest would be data on population trends and distributions for all species and sex and age composition for caribou and moose. Gaining an understanding of the relationship of species to their habitat and the amount of habitat needed for individuals or breeding pairs also would be very important.

For many residents of the North Slope, subsistence is the most important issue addressed in this document; and concern about the possible effects of the management actions being considered in this document was a consistent theme during public meetings. One major recommendation that came out of a subsistence workshop panel held in Barrow and Nuiqsut as part of the planning process was the development of a subsistence-monitoring program. The approach to inventory described here is a major part of that program. Under alternatives B through E, the BLM will work with the Subsisience Advisory Panel and the NSB to develop a program to monitor the effects of oil and gas development on subsistence users.

8. **Vegetation:** Inventory and monitoring are important strategies in meeting the objective of identifying key habitats for various wildlife species, including waterfowl, and conserving populations of rare plant species. The BLM soon will complete a digital land-cover classification of the study area. This database will be analyzed in conjunction with other data on observed occurrence of wildlife species and known rare plant locations to identify correlations that may exist. This information will then be used to identify critical habitats, potential habitat expansion areas, or areas that are likely to sustain rare plants. These areas can then be sampled to determine the validity of the correlations and interpretations. Monitoring of vegetation, either through remote sensing or on-the-ground studies, would be conducted to detect any change over time. Site-specific surveys to locate populations of rare plants would occur ahead of any surface development.

9. **Water Resources:** Inventory and monitoring would help to provide data that are necessary to minimize undue and unnecessary degradation to water resources within the planning area and adjacent watershed. Inventories would identify the water-resource availability and requirements for the planning area and adjacent watersheds. Hydrology and limnology will be correlated to critical aquatic habitat areas for fisheries and waterfowl. Both fieldwork and Geographic Information System mapping would be necessary. Field studies would take the form of instream flow and stream gaging in high-resource-value areas, and the causes of change in water quality would be identified when possible.

10. **Well site Management:** Inventory and evaluation of previously drilled oil and gas exploration wells would determine whether they should be plugged or left open to support ongoing research programs. Geographic Positioning System locations are needed along with records of the location of wells in relation to significant physiographic and human structures; see Section III.A.1.f of this environmental impact statement.

11. **Wildlife:** Inventorying and monitoring species are essential to managing lands to

maintain healthy wildlife populations. Federal, State, and NSB agencies focus their separate and joint inventory work in the planning area on certain species based on the agencies' missions and the results of public interest. Ongoing inventories in which BLM is a participant include caribou calving, composition and movement of the Teshekpuk Lake herd, raptor breeding along the Colville River, and breeding land birds in the Umiat area. Funding permitting, BLM might participate in additional future inventorying and monitoring of population demographics of spectacled and Steller's eiders, moose, and muskoxen. See the subsistence discussion in paragraph 7 above for a discussion of how fish and subsistence inventory and monitoring are related.

APPENDIX B

Effects of a Low Probability, High-Effects Very Large Oil-Spill Event

EFFECTS OF A LOW-PROBABILITY, HIGH-EFFECTS, VERY LARGE OIL-SPILL EVENT

Assumptions for the 200,000-bbl Oil Spill: The environmental impacts of low-probability, high effects, very large tanker spill along the TAPS Tanker Route is analyzed in the Gulf of Alaska/Yakutat Planning Area Oil and Gas Lease Sale 158 (USDOI, MMS, 1995). This appendix uses that information to analyze tanker spills occurring from oil production in the Northeast NPR-A Planning Area. For estimates of the chance of one or more tanker spills occurring from oil production in the planning area, refer to Table IV.A.2-5b.

The potential effects of a catastrophic spill of 200,000 bbl are analyzed on representative areas of sensitive resources in the Gulf of Alaska. A very large oil spill is a low-probability event that has the potential for very high effects on the environment. For purposes of analysis, this large oil spill is assumed to occur along the TAPS tanker route in the Gulf of Alaska. The offshore area between Dry Bay and Lituya Bay was chosen as a spill point for this analysis based on the diversity of exposed sensitive environmental resources from an oil spill in this area (Fig. IV.I-1). The spill size was chosen based on the two largest tanker spills in U.S. waters, the *Burma Agate* near Galveston (247,500 bbl) and the *Exxon Valdez* in Prince William Sound (258,000 bbl) (Anderson, oral comm., 1994; Wolfe et al., 1994). The selected area is affected by a 200,000-bbl hypothetical spill with characteristics identified in the following scenario.

Tanker-Spill Scenario: A hypothetical tanker spill occurs along Tanker Segment T6 with onshore winds in summer (Fig. IV.I-1). The 70,000-dead-weight-ton tanker releases 200,000 bbl of Cook Inlet-like crude oil. Weather conditions hamper cleanup activities in the first 10 days and the oil is washed ashore, contacting the coastline within 10 days and affecting the exposed portion of the area within 30 days after its release.

Figures IV.I-1 and IV.I-2 graphically present the estimated conditional probabilities (expressed as percent chance) that an oil spill starting at Tanker Segment T6 in the summer season would contact individual Land Segments (LS's), Sea Segments (SS's), and Environmental Resource Areas (ERA's) within 3, 10, and 30 days, assuming that a >1,000-bbl spill occurs along Tanker Segment T6 (USDOI, MMS, 1995).

The hypothetical 200,000-bbl spill occurs approximately 60 km due east of the coast between Dry Bay and Lituya Bay along Tanker Segment T6. The current regime in the vicinity of this hypothetical 200,000-bbl spill is characterized by the flow of the Alaska Current and the Alaska Coastal Current. These currents move the oil spill to the north and west along the Gulf of Alaska.

Within 10 days during summer, the Oil-Spill-Risk Analysis (OSRA) estimates oil-spill contact to Kayak Island, Cape Suckling, the area adjacent to Bering Glacier and Kaliakh River (LS's 68, 69, 70 and 71), and the area from the Yahtse River to Yakutat Bay (LS's 74, 75 and 76) from a spill occurring along Tanker Segment T6 (Fig. IV.I-2). By the end of day 30, the OSRA estimates contact to Gore Point and the Pye Islands (LS's 56 and 58) and from Elrington and Latouche Island to Cape Fairweather (LS's 61 through 80) from a spili occurring along Tanker Segment T6 (Fig. IV.I-2).

During summer by the end of day 10, the OSRA estimates oil-spill contact to ERA's 5 through 8 from a spill occurring along Tanker Segment T6 (Fig. IV.I-2). By the end of day 30, the OSRA estimates oil-spill contact to ERA's 5 through 15 and 18 and to SS 1 and 2 from a spill occurring along Tanker Segment T6 (Fig. IV.I-2).

Using the oil-weathering model of Kirstein, Payne, and Redding (1983), the mass balance estimates from the *Amoco Cadiz* oil spill (Gundlach et al., 1983) and the *Exxon Valdez* oil spill (EVOS) (Wolfe et al., 1993), and Table IV.I-1, a qualitative mass balance for a hypothetical oil spill of 200,000 bbl is presented in Table IV.I-2. Approximately 30 percent of the oil is dispersed into the water column. A large component—approximately 28 percent—comes ashore. Approximately 30 percent of the oil is lost to the atmosphere due to evaporation. After 60 days, the oil (7,000 bbl) represented by the slick is no longer visible as a coherent slick and is in the form of tarballs and tar particles suspended in the water column.

Table B-1
Hypothetical 200,000-bbl Tanker-Spill-Size Examples[1]

	200,000-bbl spill[2]					
Time After Spill in Days	1	3	10	30	45	60
Oil Remaining (%)	79	70	53	37	33	31
Oil Dispersed (%)	2	7	19	32	35	37
Oil Evaporated (%)	16	21	26	29	30	30
Thickness (mm)	5.1	2.9	1.4	0.7	0.5	0.4
Area of Thick Slick (km^2)[3]	4.7	7.3	12	17	19	21
Discontinuous Area (km^2)[4]	88.0	365.2	1,737.5	7,210.9	12,192.6	17,698.7

Source: USDOI, MMS, Alaska OCS Region, 1993.

[1] Calculated with the SAI oil-weathering model of Kirstein, Payne, and Redding (1983). These examples —for a Cook Inlet Crude type— are discussed in Section IV.A, Fate and Behavior.

[2] Summer 11.7-kn-windspeed, 9.9-°C, 1.0-m-wave height. Average Weather Marine Area C (Brower et al., 1988).

[3] This is the area of oiled surface.

[4] Calculated from Equation 6 of Table 2 in Ford (1985): the discontinuous area of a continuing spill or the area swept by an instantaneous spill of a given volume.

Table B-2
Mass Balance of Oil Through Time of a Hypothetical 200,000-bbl Oil Spill Along Tanker Segment T6

Days	1	3	10	30	45	60
Oil Evaporated[1]	30,000[2]	40,000	48,000	56,000	58,000	58,000
Oil Disbursed[1,3]	4,000	9,000	31,000	55,000	57,000	60,000
Oil Sedimented[1,3]	0	5,000	9,000	11,000	13,000	16,000
Oil Onshore[1,3]	0	17,000	30,000	40,000	45,000	55,000
Oil Remaining[1,3]	162,000	125,000	78,000	36,000	23,000	7,000

Source: MMS, Alaska OCS Region, 1993.

[1] Calculated with the SAI oil-weathering model of Kirstein, Payne, and Redding (1983).
The examples are for a Cook Inlet crude type in Summer 9.9-°C sea-surface temperature and 11.7-kn winds.

[2] Barrels.

[3] Modified to fit fate calculations of Gundlach et al. (1983) and Wolfe et al. (1993).

As stated in the mass balance, approximately 55,000 bbl would be onshore after 60 days. The approximately 55,000 bbl of oil is estimated to landfall portions of the shores of the northern Gulf of Alaska and Prince William Sound, based on the OSRA results discussed above from a spill along Tanker Segment T6.

Theoretical calculations of slick size from a hypothetical spill of 200,000 bbl were investigated using the equations of Ford (1985) and Kirstein, Payne, and Redding (1983). Table IV.I-1 shows the estimated areal extent of a continuous thick slick and a discontinuous slick through time.

1. Air Quality: Under this analysis, a 200,000-bbl-oil spill would affect onshore air quality. Emissions would result from evaporation and burning of the spilled oil.

A discussion of air-quality regulations and procedures can be found in Section IV.B.3.a. Evaporation of spilled oil is a source of gaseous emissions. Modeling predictions of hydrocarbon evaporation (Payne et al., 1984a,b, 1987) from a 200,000-bbl slick over 30-day periods estimate that 56,000 bbl—or 7,817 tons—of hydrocarbons would evaporate. Because approximately 10 percent of gaseous hydrocarbons are nonmethane volatile organic compounds (VOC), 781.7 tons of VOC would be lost to the atmosphere. The movement of the oil slick during this time would result in lower concentrations and dispersal of

Table B-3
200,000-bbl Spill Dispersed-Oil Characteristics

Time after Spill in Days[1]	Oil Dispersed[1] (%)	Discontinuous Area[1] (km^2)	Assumed Dispersion Depth (m)	Dispersed-oil Concentration (µg/l)
1	2	88.0	1	6,477
3	7	365.2	2	2,731
10	19	1,737.5	7.5	416
30	32	7,210.9	15	84
45	35	12,192.6	17.5	47
60	37	17,098.7	20	30

Source: USDOI, MMS, Alaska OCS Region, 1993. [1] Table B-1.

emissions over an area several orders of magnitude larger than the slick itself.

In situ burning is a preferred technique for cleanup and disposal of spilled oil in oil-spill-contingency plans. For catastrophic oil spills, in situ burning may be the only effective technique for spill control.

Burning could affect air quality in two important ways. Burning would reduce emissions of gaseous hydrocarbons by 99.98 percent and slightly increase emissions—relative to quantities in other oil and gas industrial operations—of other pollutants. If the oil spill were ignited immediately after spillage, the burn would combust 33 to 67 percent of the crude oil or higher amounts of fuel oil that otherwise would evaporate. On the other hand, incomplete combustion of oil would inject about 10 percent of the burned crude oil as oily soot, plus minor quantities of other pollutants, into the air. For a 200,000-bbl spill, setting fire at the source could burn up to 85 percent of the oil—with 5 percent remaining as residue or droplets in the smoke plume—in addition to the 10-percent soot injection (Evans et al., 1987). Clouds of black smoke from a 360,000-bbl oil-spill tanker fire 75 km off the coast of Africa locally deposited oily residue in a rainfall 50 to 80 km inland. Later the same day, clean rain washed away most of the residue and allayed fears of permanent damage.

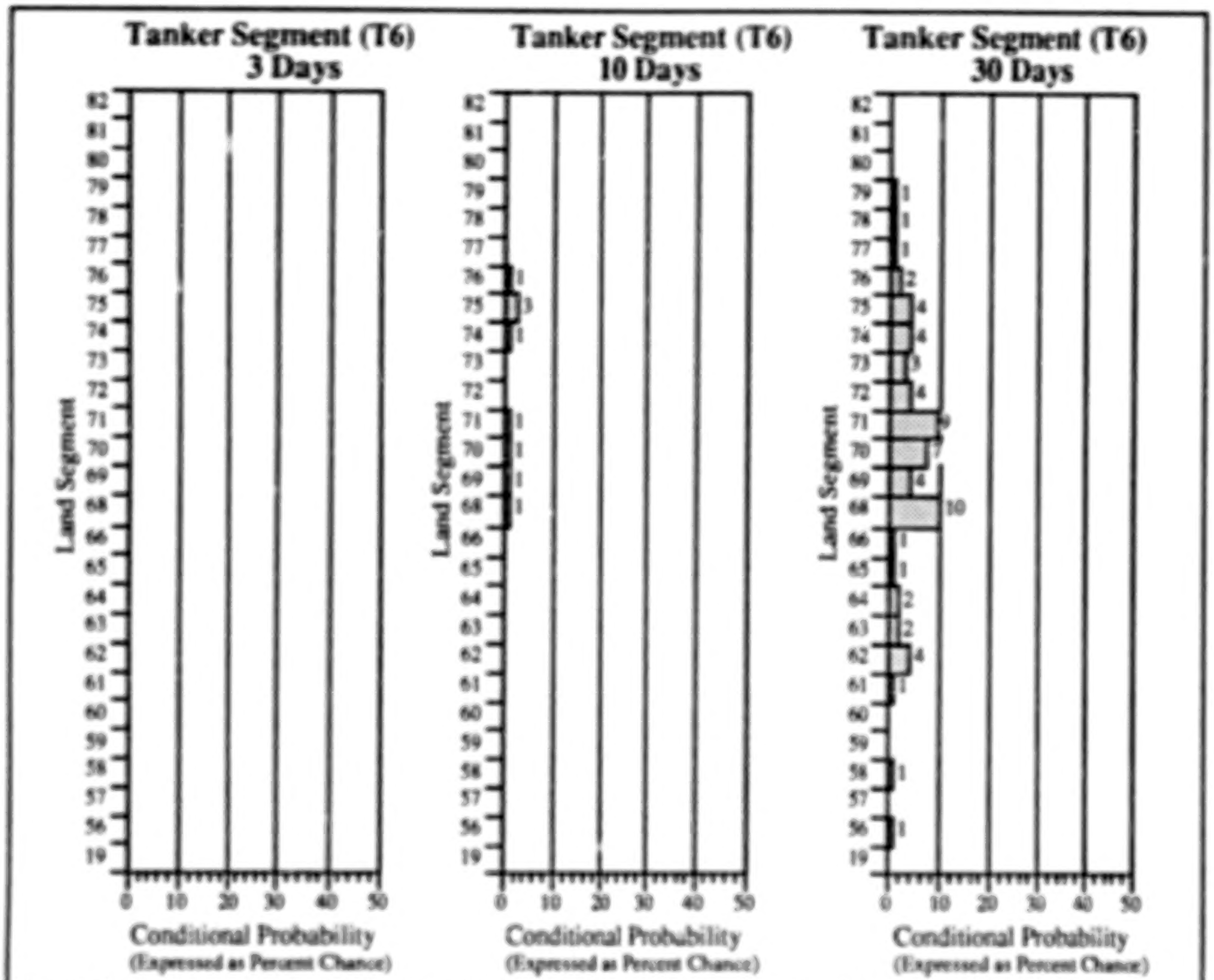
Coating portions of the ecosystem in oily residue is the major, but not the only, potential air-quality risk. Recent examination of polycyclic aromatic hydrocarbons (PAH) in crude oil and smoke from burning crude oil indicate that the overall amounts of PAH change little during combustion, but the kinds of PAH compounds present do change. Benzo(a)pyrene, which is often used as an indicator of the presence of carcinogenic varieties of PAH, is present in crude-oil smoke in quantities approximately three times larger than in the unburned oil. However, the amount of PAH is very small (Evans, 1988). Investigators have found that overall, the oily residue in smoke plumes from crude oil is mutagenic but not highly so (Sheppard and Georghiou, 1981; Evans et al., 1987). The Expert Committee of the World Health Organization considers daily average smoke concentrations of more than 250 micrograms per cubic meter to be a health hazard for bronchitis.

Large fires create their own local circulating winds—toward the fire at ground level—that affect plume motion. In any event, soot produced from burning oil spills tends to slump and wash off vegetation in subsequent rains, limiting any health effects in the very short term. Accidental emissions are, therefore, expected to have a low effect on onshore air quality.

Conclusion: Concentrations of criteria pollutants would remain well below Federal air-quality standards.

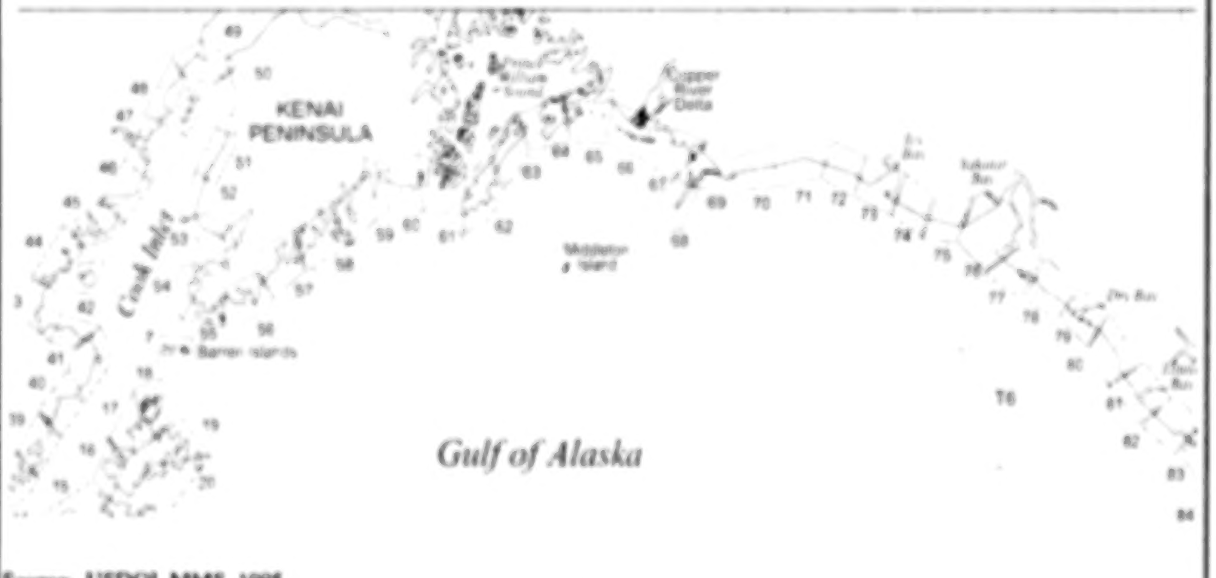
2. Water Quality: Accidental oil spills would add substances that may be foreign to or increase the concentration of constituents already present in the water column of the northeastern Gulf of Alaska. In general, the added substances may cause sublethal effects in some marine organisms if concentrations are greater than the chronic criteria and lethal effects if concentrations are greater than acute criteria. This analysis considers 15 µg/l to be a chronic criterion and 1,500 µg/l—a hundredfold higher level—to be an acute criterion for total hydrocarbons.

The effects of a very large, 200,000-bbl oil spill on water quality are based on the amount of oil dispersed into the



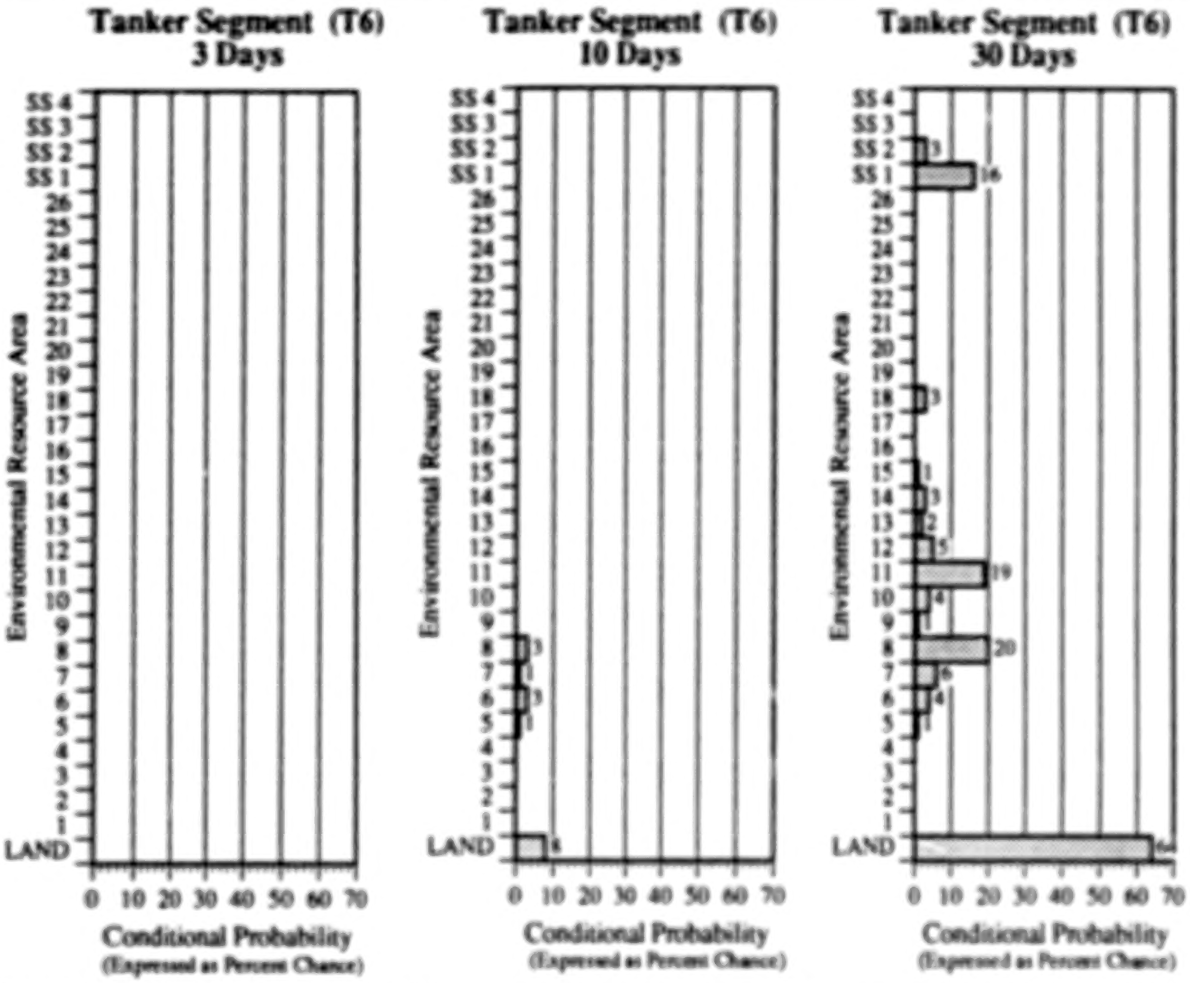
Note: Only land segments with >0.5 conditional probability (expressed as percent chance) are shown on the graph. Land Segments with all values less than 0.5 conditional probability (expresses as percent chance) are not shown.

Land Segments



Source: USDOI, MMS, 1995.

Figure B-1. Estimated Conditional Probabilities (expressed as percent chance) That an Oil Spill Greater Than or Equal to 1,000 Barrels Starting at Hypothetical Tanker Segment 6 (T6) in the Summer Season Will Contact a Certain Land Segment within 3, 10, or 30 Days



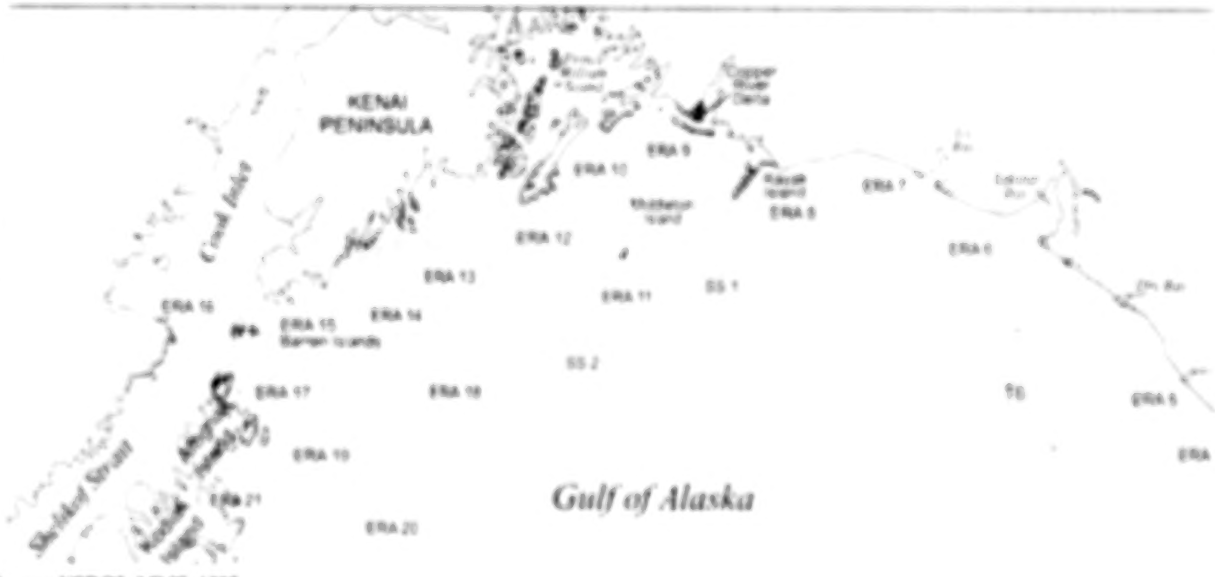
Tanker Segment (T6) 3 Days

Tanker Segment (T6) 10 Days

Tanker Segment (T6) 30 Days

Note: Only ERA's with >0.5 conditional probability (expressed as percent chance) are shown on the graph. ERA's 1-4, 16, 17, 19-26, and SS's 3 and 4 have <0.5 conditional probability (expressed as percent chance).

Environmental Resource Areas



Source: USDOI, MMS, 1995

Figure B-2. Estimated Conditional Probabilities (expressed as percent chance) That an Oil Spill Greater Than or Equalto 1,000 Barrels Starting at Hypothetical Tanker Segment 6 (T6) in the Summer Season Will Contact Certain Environmental Resource Areas (ERA), Sea Segments (SS), and Land within 3, 10, or 30 Days

534

water column; the characteristics of the oil spill are noted in Tables IV.I.1 and IV.I.2. The concentrations are simply estimated from the amount of oil dispersed into the water column for each time interval by assuming that (1) the extent of the discontinuous area estimated for the surface extends into the water column; (2) the depth of mixing is 2 m after 3 days, 7.5 m after 10 days, and 15 m after 30 days; (3) the concentration of the dispersed oil is uniform in the "mixed" watermass; (4) other processes, except sedimentation, affecting degradation of oil or removal of oil from the water column are neglected; and (5) the weight of a barrel of oil is 314.26 pounds.

The waters of the northeastern gulf are stratified in the summer; vertical mixing in the surface layer may be limited to the upper 20 to 25 m. For depth-of-mixing estimates, it is assumed that the oil will be dispersed into the water column to a depth equivalent to the mean-monthly significant wave height of 2 m. At the end of 10 days, the oil is assumed to have dispersed to a depth of 7.5 m. At the end of 30 days, the oil is assumed to have dispersed to a depth of 30 m. The depth of mixing during the first day is assumed to be 1 m. Table IV.I.2 shows the estimates of the amount of oil remaining in the water and removed by sedimentation and evaporation for time intervals from 1 to 60 days.

For a 200,000-bbl spill, the estimated concentrations of oil dispersed into the water column are shown in Table IV.I-3. The high concentrations of oil associated with estimating dispersal in the water column may represent an upper range of dispersed-oil concentrations reached during the first several days following a large spill; these concentrations are greater than the total hydrocarbon acute criterion of 1,500 µg/l that was used to evaluate the effects of a 29,000-bbl spill and smaller spills. Between 10 and 30 days after the spill, concentrations of dispersed oil are within the range of concentrations reported for tanker spills of 0.18 and 1.6 MMbbl of oil (NRC, 1985; Gundlach et al., 1983). The amount of dispersed oil in the water after 30 to 60 days emphasizes the time it would take before the oil is reduced to concentrations that are below the total hydrocarbon chronic criteria—15 µg/l—and eventually disappears from the water. Dilution rates associated with permitted discharges suggest that the dispersion rates of oil droplets in the water column may be greater than those estimated for this spill.

Conclusion: The water quality would be reduced from good (unpolluted) to polluted by the presence of hydrocarbons from a large (200,000-bbl) oil spill that has a relatively low probability of occurring. Contamination (the presence of hydrocarbons in amounts >15 µg/l) would be temporary (last for about 2 months or more) and affect an area between 10,000 and 20,000 km^2.

3. Lower-Trophic-Level Organisms: The 200,000-bbl oil spill would expose some lower-trophic-level organisms to petroleum-based hydrocarbons.

The effect of petroleum-based hydrocarbons on phytoplankton, zooplankton, and benthic organisms ranges from sublethal to lethal. Where flushing times are longer and water circulation is reduced (e.g., bays, estuaries, and mudflats), adverse effects are expected to be greater; and the recovery of the affected communities is expected to take longer. Large-scale effects on plankton due to petroleum-based hydrocarbons have not been reported. Assuming that a large number of phytoplankton were contacted by an oil spill, the rapid replacement of cells from adjacent waters and their rapid regeneration time (9-12 hours) would preclude any major effect on phytoplankton communities. Observations in oiled environments show that zooplankton communities experience short-lived effects due to oil. Affected communities appear to recover rapidly from such effects because of their wide distribution, large numbers, rapid rate of regeneration, and high fecundity. Large-scale effects on marine plants and invertebrates due to petroleum-based hydrocarbons have not been reported. The sublethal effects of oil on marine plants include reduced growth and photosynthetic and reproductive activity. The sublethal effects of oil on marine invertebrates include adverse effects on reproduction, recruitment, physiology, growth, development, and behavior (feeding, mating, and habitat selection).

The 200,000-bbl spill is assumed to occur offshore (Tanker Segment T-6). It is also assumed that a portion of it (an estimated 30,000 bbl) will contact the shore within 10 days and cover a discontinuous surface area on the water of about 1,737 km^2. Hence, the 200,000-bbl spill would substantially increase the amount of oil contacting the gulf shoreline and surface waters. For this reason oil from the 200,000-bbl spill is likely to remain in the affected shoreline sediments longer.

Regarding the shoreline most likely to be contacted, the OSRA estimates that the conditional probability (expressed as percent chance) of an oil spill contacting the shore within 10 days ranges from 1 to 4 percent for 9 eastern land segments (L.S.'s 68-76; Appendix C, Table C-11). Conditional probabilities (expressed as percent chance) west of this are <0.5 percent. The OSRA estimates that the conditional probability (expressed as percent chance) of contact within 30 days ranges from 1 to 8 percent for 27 land segments (L.S.'s 7-76 Appendix C, Table C-13). However, the 30-day conditional probability (expressed as percent chance) of oil contacting the shore is generally lowest west of Resurrection Bay (1-3%) and highest east of Cape Saint Elias (2-8%). Hence, a majority of the oil from the 200,000-bbl spill that would be washed ashore is expected to contact shoreline areas from Cape Saint Elias east to Icy Bay. A much smaller amount of extremely weathered oil is expected to contact some shoreline areas to the west of Cape Saint Elias.

Based on the above, this analysis has assumed that the 200,000-bbl spill would contact about 40 percent more gulf shoreline, and 300 percent more surface water, with about three times as much oil. Within the sale area, all of the above differences are estimated to increase effects on marine plants and invertebrates in the intertidal area by about 40 percent, and to increase effects on plankton in open-water areas by about 300 percent. However, these increases are expected to have little effect on recovery times in the Gulf of Alaska. This is due primarily to the high rate of hydrologic exchange in open-water areas and the amount of heavy wave action in most intertidal areas.

Based on these estimates and assumptions, the 200,000-bbl oil spill is estimated to have sublethal and lethal effects on 1 to 5 percent of the phytoplankton and zooplankton populations in the sale area. Recovery is expected to take 1 or 2 days for phytoplankton and up to 1 week for zooplankton. The total percentage of plankton affected could increase to about 10 percent if many embayments were contacted by the spill. Recovery within the affected embayments is expected to take 1 to 2 weeks. Most marine plants and invertebrates in subtidal areas are not likely to be contacted by an oil spill (contact estimated at <5%). The 200,000-bbl oil spill is estimated to have lethal and sublethal effects on about 40 to 50 percent of the intertidal and shallow subtidal marine plants and invertebrates in the sale area. Recovery of these communities is expected to take 2 to 3 years in high-energy habitats and up to 7 years in lower-energy habitats.

Conclusion: The 200,000-bbl oil spill is estimated to have lethal and sublethal effects on 1 to 10 percent of the plankton in the proposed sale area. Recovery is expected to take 1 or 2 days for phytoplankton and up to 1 week for zooplankton. The spill also is estimated to have lethal and sublethal effects on about 40 to 50 percent of the intertidal and shallow subtidal marine plants and invertebrates in the sale area. Recovery of these communities is expected to take 2 to 3 years in high-energy habitats and up to 7 years in lower-energy habitats. Less than 5 percent of the subtidal benthic populations in the sale area are expected to be affected.

4. Fishes: The assumed 200,000-bbl-oil spill from a tanker accident that occurs in the southern portion of the sale area during the summer would adversely affect pelagic, semidemersal, and demersal fish that inhabit these waters. The adverse effects, ranging from sublethal to lethal in the event of contact by oil, would not, however, reach any appreciable number of fishes. The 200,000-bbl oil spill would not reach any large ocean area with persistent toxicity (Malins, 1977). These factors, when compared with the large regional fish populations, the seasonal migratory behavior of many species, the low densities within a given habitat, and the wide distribution of the populations over this region and within the sale area, would cause only a very small percentage of a population to be contacted by the assumed 200,000-bbl spill.

Salmon smolt and fry would be at risk during summer. Salmon have economic importance and are abundant over much of Alaska. Salmon smolt and fry would be transiting the coastal area during this time. As revealed by the EVOS studies in Prince William Sound, pink salmon fry would suffer reduced growth due to the metabolic cost of depurating a spill-related hydrocarbon burden (Wertheimer et al., 1993; Carls et al., 1993), and the slower growth of juvenile pinks may have caused an incremental reduction in survival to adulthood. Small numbers of smolt from other salmon species would also be contacted. The coastal areas that are oiled, however, do not represent a large segment of the salmon-spawning habitat or migration routes; e.g., in Prince William Sound, a relatively small segment of pink salmon streams was oiled by the EVOS. In three salmon-management districts with 209 identified spawning streams, 29 (14%) actually were on oiled shorelines (Maki et al., 1993). A 200,000-bbl oil spill in offshore waters would have the potential to contact fewer of the larger number of pink salmon-spawning streams and, given the depth at which salmon fry and other salmon usually migrate, perhaps <1 percent of the migrants would be at risk from a 200,000-bbl oil spill.

Pacific herring would also be adversely affected by a 200,000-bbl oil spill because their eggs are laid within the littoral zone, and the resulting larvae and fry spend their first summer in shallow coastal waters before moving offshore in the fall. The number of herring larvae and juveniles that would be affected is indeterminate. However, given the size and distribution of herring populations in the Gulf of Alaska and the limited coastal area contacted, there probably would not be a large-scale loss of herring from a 200,000-bbl oil spill.

Some semidemersal fishes might be injured by contact with a large oil spill; but given their usual habitat in deeper waters, only the limited, low-concentration water-soluble fractions of the oil would reach these depths where it is no longer at concentrations toxic to semidemersal fishes (Kineman, 1980). During summer, some pelagic larvae and juveniles of semidemersal fishes might be at the surface but at comparatively low densities because the pelagic zone where they occur extends to 50 m in deeper waters. Larvae and juveniles are also widely distributed. For these reasons, no appreciable number of larvae or juveniles of semidemersal fishes would be adversely affected by the spill.

Demersal fishes, well offshore and at depth, are not likely to be contacted or affected by the oil spill. Those demersal species with pelagic larvae and juveniles might be affected in the immediate zone of the oil spill, but the numbers so affected would not comprise large numbers of the total populations. This is because densities per square meter of seawater do not range above units of tens, while egg complements of most demersal species range in the thousands (Bakkala, 1975).

Laevastu et al., (1986) assessed the potential effects of a 240,000-oil spill on eastern Bering Sea fishes. They estimated that <0.3 percent of yellowfin sole eggs and larvae would be killed (yellowfin sole were used as an indicator species for all demersal and semidemersal fishes in the study). Laevastu et al. also estimated that a *maximum* 13-percent mortality of outmigrating smolt could occur and that this could translate into a 5-percent loss in returning adults. Because these estimated losses are significantly lower than measurement errors (20-90%) associated with assessing changes in stock size, the authors concluded that a " . . . tanker accident would have no quantifiable effect on the offshore fishery resources in the eastern Bering Sea." While the eastern Bering Sea and the Gulf of Alaska are physiographically different, they support similar biotic (fish) communities that would be affected by spilled oil in similar fashions. While Laevastu's results are not directly transferable to the Gulf of Alaska, they provide a conservative estimate of the level of effects that can be expected.

Conclusion: The effects on fishes from a 200,000-bbl oil spill are not expected to cause population-level changes. The assumed 200,000-bbl oil spill is estimated to affect <0.3 percent of the offshore marine fisheries resources and <5 percent of the adult salmon resources in the area. However, these conservatively estimated losses would not be detectable using standard fisheries-population-assessment methods.

5. Marine and Coastal Birds: The assumed 200,000-bbl tanker spill would occur offshore Cape Fairweather along Tanker Segment T6 during the summer with onshore winds (Fig. IV.I-1). Within 10 days the spill is estimated to have swept over a discontinuous area of 1,737.5 km^2; after 60 days the area of continuous slick is estimated to be 21 km^2 (Table IV.I-1). A portion of the spill is expected to contact marine and coastal bird habitats used especially during winter and spring-migration periods (murrelets and terns in summer) within Yakutat and Icy Bays and near Kayak Island (ERA's 6, 7 and 8), as well as in the Fairweather Ground and Middleton Island areas (ERA's 5 and 11), as shown in Figure IV.I-2.

Oil-spill mortality in winter and early spring in coastal areas adjacent to the spill area is likely to involve overwintering loons and grebes, cormorants, sea ducks, marbled and Kittlitz's murrelets, pigeon guillemots, gulls, and bald eagles. Based on proportional estimates from EVOS data (Ford et al., 1991; Piatt et al., 1990) and season of occurrence, and assuming equal contact in all habitats, the following approximate carcass recoveries would be expected from a spill in winter/early spring: 337 loons, 382 grebes, 674 cormorants, 1,190 sea ducks, 494 murrelets, 494 guillemots, 539 gulls, and 25 bald eagles. For any of these estimates, actual mortality may be three- to tenfold greater because of failure to recover most carcasses. Effects are expected to be most severe in species such as the yellow-billed loon, pelagic cormorant, harlequin duck, Kittlitz's murrelet, and bald eagle, where even modest losses represent a large proportion of the local—or in some cases Alaskan—populations. Greater mortality in species such as the marbled murrelet and pigeon guillemot, while locally serious in terms of loss to slowly reproducing species, is not expected to represent as severe a loss because of their substantial Alaska populations. Recovery periods for this level of mortality are expected to range from two to five generations.

Mortality in late spring is expected to include larger numbers of migrant waterfowl and shorebirds. Northwest of the spill area the Copper River Delta in particular, while not as likely to be contacted, could suffer catastrophic losses to several populations (potentially 10,000-50,000 individuals of western sandpiper, dunlin, dusky Canada goose) during the spring-migration period, requiring several generations (more for the goose) for recovery. Offshore seabird densities in spring average about 88 birds/km^2, with the potential for tens of thousands of fatalities if the spill swept an area of several hundred square kilometers or more. Recovery from such losses is expected to require at least two to three generations.

After departure of overwintering and southern-latitude migrants, spill mortality in summer is expected to include cormorants, arctic and Aleutian terns, murrelets, guillemot, puffins, and bald eagle in these coastal areas; recovery periods are not likely to change significantly, but substantial mortality at the large Aleutian tern colony near Yakutat would be expected and could represent a serious loss for this species with its relatively small population. Offshore, a spill occurring and contacting primarily the Middleton Island area in summer is expected to cause substantial murre mortality as well as losses of kittiwakes and rhinoceros auklets (potentially 10,000 or more individuals [Gould, Forsell, and Lensink, 1982]). Recovery is expected to require two or more generations. A spill moving into offshore areas could contact many tens of thousands of southern-hemisphere shearwaters present in large flocks during summer, but recovery of this abundant seabird probably would occur rapidly.

Summer density of the marbled murrelet in the immediate vicinity of Yakutat Bay ranges from 0.65 to 1.36 birds/km^2, declining to <0.31/km^2 beyond 50 km offshore and most of the area northwest of the bay. The potential spill associated with TAPS traffic is expected to cover a discontinuous area of 7,211 km^2 after 30 days (Table IV.I-1), suggesting that murrelet mortality could total up to many hundreds of individuals. Supporting estimates of potential mortality of this magnitude, murrelets retrieved following the EVOS totaled about 780 (includes natural mortality), probably representing 10 to 30 percent of the total murrelet deaths during this period (Piatt et al., 1990); potential mortality values must be decreased somewhat because the size of this potential spill is 77 percent of the EVOS. Although murrelets have a low productivity, the large size of the eastern gulf population suggests that such mortality would be recovered within a few generations. Offshore average seabird densities in summer are somewhat less than in spring (69 birds/km^2), but mortality would not be expected to be less because of the loss of some eggs and/or young through contact with oiled adults.

Conclusion: The effect of exposure of marine and coastal birds to a 200,000-bbl oil spill in this region is expected to seasonally affect the yellow-billed loon, pelagic cormorant, harlequin duck, Aleutian tern, Kittlitz's murrelet, and bald eagle most severely, causing mortality of many hundreds of these marine birds and tens of eagles, requiring two to five generations for recovery. A spill approaching Middleton Island could contact 10,000 or more murres, kittiwakes, and auklets, requiring two or more generations for recovery.

6. Nonendangered Marine Mammals (Pinnipeds, Cetaceans, and Sea Otters): This analysis assumes that a 200,000-bbl tanker spill occurs offshore Cape Fairweather along Tanker Segment T6 during the summer with onshore winds (Fig. IV.I-1). Within 10 days the spill is estimated to have swept over a discontinuous area of 1,737.5 km (Table IV.I-1); and a portion of the spill is estimated to have contacted sea otter, harbor seal, and nonendangered cetacean habitats within Yakutat and Icy Bays (ERA's 6 and 7, respectively); sea otter and harbor seal habitats near Kayak Island (ERA 8); and northern fur seal habitat in the Fairweather Ground (ERA 5), as shown in Figure IV.I-2. Sea otters within Yakutat Bay and near Kayak Island are expected to be exposed to the spill and to suffer substantial losses (perhaps several hundred animals) to the local populations, with recovery taking more than one generation (perhaps >5 years).

Assemblages of harbor seals in Yakutat and Icy Bays and near Kayak Island are expected to be exposed to the spill and a number (perhaps several hundred or more) of them are likely to become oiled and absorb petroleum hydrocarbons through their skin and suffer physiological/toxic stress that might lead to the death of a number of oiled seals (perhaps 100-200 animals), with recovery from this loss taking place within less than one generation (probably 2 years). Groups of northern fur seals (perhaps a few hundred to a few thousand) migrating through the northern gulf in the Fairweather Ground are likely to be exposed to the spill in this offshore habitat. Several hundred to a few thousand fur seals are likely to become oiled and to suffer hypothermia due to oiling of their fur, and many or most of the oiled fur seals are assumed to be killed by this exposure to the spill. Recovery of the Pribilof Islands northern fur seal population (>800,000 seals) is expected to take place within 1 year through population recruitment.

Within 30 days after the spill, more of the spill is expected to contact Kayak Island habitats of sea otters and harbor seals as well as Yakutat and Icy Bays. The spill is estimated to contact sea otter and harbor seal habitats near Montague and Hinchinbrook Islands (ERA's 12 and 10, respectively) and along the lower Kenai Peninsula (ERA's 13 and 14), and to contact northern fur seal and cetacean offshore habitats southwest of Kayak Island (SS 1) westward to Portlock Bank (SS 2 and ERA 18), as shown in Figure IV.I-2. Rafts of sea otters and assemblages of harbor seals along the gulf coast side of Montague and Hinchinbrook Islands and along the lower Kenai Peninsula are likely to be exposed to part of the 200,000-bbl spill and to suffer some losses (such as several hundred sea otters and perhaps 100 or fewer harbor seals). At 30 days the spilled oil is expected to be very dispersed and at least partly weathered, with much of the toxic components lost; thus, the losses of harbor seals and perhaps sea otters to oil contact at this stage of the spill are expected to be less than losses during the first 10 days of the spill.

Groups of northern furs seals migrating and feeding in offshore habitats southwest of Kayak Island and in Portlock Bank are likely to have some exposure to the spill within days. This exposure is expected to result in the oiling of some fur seals (perhaps a few hundred to a few thousand animals) and the assumed loss of most if not all of these fur seals due to hypothermia from the oiling and reduced thermal insulation.

Cetaceans within Yakutat Bay, such as harbor seal, Dall's porpoise, and killer and gray whales migrating along the coast between Yakutat Bay and Kayak Island at the time the spill contacts these habitats, might encounter oil on the surface of the water when breathing and resting. These encounters are not expected to result in mortalities unless the cetaceans encounter a very large, continuous oil slick of fresh, highly toxic oil from the spill and consequently inhale lethal amounts of toxic fumes, which results in the death of highly exposed whales or porpoises. The number of cetaceans lost to such possible encounters is expected to be few (probably <10 animals). If such losses occurred in a family group of killer whales, recovery could take more than one generation (such as >10 years). However, populations of killer whales, porpoises, and other cetaceans in the gulf are likely to replace the loss of 10 to 20 individuals within 1 year.

Cetaceans that might encounter oil from the spill within offshore habitats, such as Fairweather Ground or Portlock Bank, are not expected to suffer any lethal exposure to the spill because the oil is expected to be highly dispersed in these offshore habitats and quite weathered when encountered in the Portlock Bank area.

Conclusion: The potential total loss of sea otters to the 200,000-bbl oil spill (perhaps 1,500-2,000 individuals) is likely to take more than one generation (probably >5 years) for total recovery to take place, while the potential loss of harbor seals (perhaps about 200 individuals) is likely to take less than one generation (perhaps 2 years) for recovery to take place, depending on the population status at the time of the loss and other unrelated factors adversely affecting the regional population. Potential loss of northern fur seals to the spill (perhaps 2,000-3,000 individuals) is expected to take less than one generation (probably 1 year) for recovery to take place. The potential loss of cetaceans (10-20 individuals in a population or group) is likely to affect a family group (such as a killer whale pod) for more than one generation; but such a loss to a population of whales or porpoises is expected to take about 1 year for the population to recover.

7. Endangered and Threatened Species: For the very large oil-spill case it is assumed that one 200,000-bbl-tanker spill occurs offshore approximately 60 km due east of the coast between Dry Bay and Lituya Bay along Tanker Segment T6 in the summer. The OSRA model estimates a 19- and a 20-percent chance of a spill >1,000 bbl contacting ERA 11 (Middleton Island) and ERA 8 (Kayak Island), respectively, and a 16-percent chance of that spill contacting SS 1 within 30 days during the summer—assuming that a spill occurs at Tanker Segment T6. The estimated chance of the spill contacting other ERA's ranges from <0.5 to 6 percent within 30 days during the summer (Fig. IV.I-2).

a. Whales: Exposure of endangered whales to spilled oil is not expected to occur. Only small numbers of endangered whales are expected to be present in the sale area or in areas contacted by the assumed oil spill. There is a slightly higher potential that humpback whales would be exposed to spilled oil, since humpback whales may be present in the Kayak and Middleton Island area. No effects on the humpback whale population from the EVOS were documented (Dahlheim and Loughlin, 1990). Few fin, sei, blue, right, or sperm whales are expected to be exposed to spilled oil. The estimated conditional probability (expressed as percent chance) of spilled oil contacting SS 1 (16%) is relatively low. For whales that may be in the vicinity of Kayak or Middleton Islands, the chances of contact are slightly higher (19-20%). A few whales may be exposed to spilled oil, resulting in temporary sublethal effects; but no mortalities are expected. The overall effects of exposure of endangered whales to a very large oil spill are expected to be negligible.

b. Steller Sea Lions: The very large oil spill discussed in this analysis could contact Steller sea lion haulouts on Kayak and Middleton Islands, but is not likely to contact any major rookeries. There are no major rookeries in the sale area, and the estimated chance of spilled oil contacting a major rookery adjacent to the sale area is low (<0.5-5%). The highest estimated probabilities (expressed as percent chance) for ERA's are a 20-percent chance of spilled oil contacting ERA 8 (Kayak Island) and ERA 11 (Middleton Island) within 30 days in the summer. If such a spill occurred, several hundred or more adult and subadult sea lions could be exposed to spilled oil and could experience various degrees of oiling. No changes in distribution, abundance, mortality, pup production, or other potential effects have been attributed to the EVOS (Calkins and Becker, 1990), although the population's continuing decline may have masked some effects. These data suggest relatively low effects of an oil spill on sea lions. Heavily oiled individuals may experience elevated stress that could intensify any other debilitating problems, potentially causing death. Mortalities are expected to be more than 100 individuals, requiring two generations or more for recovery. Even if the spill stays at sea, oil is expected to contact some adults in pelagic waters, resulting in sublethal effects. Overall, Steller sea lions exposed to a very large oil spill would most likely experience temporary, sublethal effects; but exposure could result in lethal effects on some animals. More than 100 mortalities are expected, requiring two generations or more for recovery.

c. Short-Tailed Albatross: Only a small percentage of the short-tailed albatross population would be likely to occur in or near the Sale 158 area. Due to the expected rare occurrence of this species in the area and the relatively low probability of spilled oil contacting their habitat, it is expected that exposure to spilled oil would not occur. The effects of a large oil spill are expected to be negligible.

Conclusion: The overall effects on endangered whales,and the short-tailed albatross from exposure to a very large oil spill are expected to be negligible. Some whales could experience temporary, sublethal effects, but no mortalities are expected. Steller sea lions exposed to a large oil spill would most likely experience temporary, sublethal effects, but exposure could result in lethal effects on some animals. More than 100 mortalities could occur, requiring more than two generations for recovery.

8. Terrestrial Mammals: This analysis assumes that a 200,000-bbl tanker oil spill occurs offshore Cape Fairweather along Tanker Segment T6 during the summer with onshore winds (Fig. IV.I-1). Within 10 days the spill is estimated to have swept over a discontinuous area of 1,738 km^2 (Table IV.I-1), and a portion of the spill is estimated to have contacted coastline habitats of terrestrial mammals from Yakutat Bay westward to Kayak Island (LS's 68-71 and 74-76), as shown in Figure IV.I-1. River otters and brown and black bears frequenting the shoreline of Yakutat Bay westward to Point Manby/Cape Sitkagi to near Icy Bay, and frequenting shoreline habitats from Cape Yakataga/Cape Suckling to Kayak Island, are expected to encounter oil from the spill along the beach and in intertidal habitats. Some river otters (perhaps >50) are likely to be oiled by the spill or to ingest oil through consumption of oiled prey and oiled carrion. A number of river otters (perhaps >50) are likely to be killed by the spill, with total recovery of the local population and intertidal habitats taking >1 year (perhaps >3 years).

Brown and black bears that frequent the above oiled shoreline habitats are likely to ingest oiled prey and oiled carrion, with perhaps 20 to 30 bears affected. Assuming that all the bears that ingest oiled food items are killed, total recovery of brown and black bear populations and local habitats is expected to take >1 year (perhaps >3 years). Although moose that occur along the shoreline of oiled shoreline habitats (Yakutat Bay/Kayak Island) may encounter oil on the beaches and mudflats while foraging on willow and other browse, they are not likely to ingest oiled intertidal vegetation during this time of the year and thus are not expected to ingest oil-contaminated vegetation and suffer mortalities or other adverse effects.

Within 30 days the 200,000-bbl oil spill is estimated to contact terrestrial mammal coastal habitats from Cape Fairweather westward to Montague Island and coastline areas on the lower Kenai Peninsula (LS's 56, 58, and 80-61, respectively), as shown in Figure IV.I-1. More oil from the spill is expected to contact river otter and brown and black bear coastal habitats from Yakutat Bay to Kayak Island, and the spill is estimated to oil other habitats along the coast of the Copper River Delta, on Hinchinbrook and Montague Islands, and along the southern coast of the Kenai Peninsula. Some additional river otters (perhaps 100-200 individuals) and black and brown bears (perhaps 50-100 individuals) are likely to come in contact with oil on the beaches and intertidal mudflats and to ingest oiled prey or carrion. However, by 30 days the beached oil is expected to be quite weathered and far less toxic than the oil that reaches the coast within 10 days; thus, fewer bears and river otters (perhaps 30-40 bears and <50 otters) are expected to suffer lethal doses of oil from ingestion of contaminated food sources. These additional losses of river otters and bears and contamination of habitats are likely to recover within less than one generation (or within about 1-2 years).

Although the coastal habitats of Sitka black-tailed deer on Montague and Hinchinbrook Islands are expected to be oiled by the 200,000-bbl oil spill, black-tailed deer are not likely to be directly exposed to the oil because they generally do not forage on kelp and other intertidal vegetation during the summer season, when the spill is assumed to occur. Thus, Sitka black-tailed deer are not expected to suffer mortalities from the spill.

Conclusion: The potential loss of river otters (perhaps 50-100 individuals) and contamination of intertidal habitats from the 200,000-bbl oil spill is estimated to take more than 1 year to recover (probably >3 years), while the potential loss of brown and black bears (perhaps 50-70 individuals) is estimated to take more than 1 year (perhaps >3 years). Neither moose nor Sitka black-tailed deer are likely to suffer mortalities or other effects from the 200,000-bbl oil spill, assuming that it occurs during the summer.

9. Economy of the Yakutat Borough: The most relevant historical experience of a tanker spill in Alaskan waters is the EVOS of 1989, which spilled 258,000 bbl. This spill generated enormous employment that rose to the level of 10,000 workers directly doing cleanup work in relatively remote locations. Smaller numbers of cleanup workers returned in the warmer months each year following 1989 until 1992. Numerous local residents quit their jobs to work on the cleanup at often significantly higher wages, which generated a sudden and significant inflation in the local economy (Cohen, 1993). Anecdotal information indicates that housing rents in Valdez in 1989 increased from 25 percent in some cases to sixfold in others, and inflated rents continued into 1990. Prices of food and other goods increased only slightly, because people could drive to Anchorage to purchase them (Henning, oral comm., 1993). Research shows that no data on inflation were gathered in a systematic way during the EVOS, although most observers agree that there was temporary inflation.

The number of cleanup workers actually used for a very large oil spill of 200,000 bbl would depend to a great extent on what procedures are called for in the oil-spill-contingency plan, how well prepared with equipment and training the entities responsible for cleanup were, how efficiently the cleanup was executed, and how well the coordination of cleanup was executed among numerous responsible entities. A very large oil spill of 200,000 bbl resulting from activity associated with Sale 158 could generate about the same number of workers associated with the EVOS—or 10,000 cleanup workers at the peak of the cleanup effort. Housing for cleanup workers would likely be located outside of Yakutat in some type of temporary enclave, such as those developed during the EVOS. Based on the EVOS experience, all communities proximate to the oil-spill-cleanup effort could experience temporary increases in wage rates and a shortage of housing, which could cause significant housing-rent increases.

Conclusion: A very large spill of 200,000 bbl would create effects similar to those experienced with the EVOS. Short-term employment could reach or exceed 10,000 people, along with price inflation above 25 percent during the first 6 months of the cleanup operation. Long-term economic effects would be minimal.

10. Commercial Fisheries: The 200,000-bbl oil spill would affect the Gulf of Alaska commercial-fishing industry by exposing it to petroleum-based hydrocarbons. The 200,000-bbl spill would substantially increase the amount of oil contacting shoreline and open-water commercial fishing grounds. Because more shoreline would be contacted with more oil, oil from the 200,000-bbl spill likely would remain for a longer period in shoreline sediments. Within the Gulf of Alaska area this is not expected to result in additional closures because any large spill is large enough by itself to close northeastern gulf commercial fisheries. However, once the spill was northwest of the TAPS tanker route (the predominate direction of ocean currents), there would be substantially more oil moving out of the area from the 200,000- bbl spill. Hence, the oil from the 200,000-bbl spill is likely to enter and more strongly affect the commercial fishing grounds within portions of Prince William Sound and farther west toward Resurrection Bay. Due to the greater presence of oil in these areas, more fishery closures are expected with a 200,000-bbl spill that moves outside of the TAPS tanker route.

The estimated economic effect of the 200,000-bbl oil spill on the gulf commercial-fishing industry is based on what occurred during the larger (258,000 bbl) EVOS and the smaller (4,000-bbl) GBOS, and depends primarily on the highly variable EVOS cost estimates (ranging from $9-43 million/year for 2 years). The value of the gulf commercial fishery (Prince William Sound to Cape Fairweather) is estimated at $75 to $200 million per year, depending on the price per year and numbers caught. Hence, in any 2-year period when the value of the northeastern gulf commercial fishery is estimated to be about $75 million per year, a 2-year loss of about $9 million per year represents a 12-percent-per-year loss for 2 years. A 2-year loss of about $43 million per year represents a 57-percent-per-year loss for 2 years. In a 2-year period when the annual value of the northeastern gulf commercial fishery is estimated to be closer to $200 million, a 2-year loss of about $9 million per year represents a 5-percent-per-year loss for 2 years, whereas a 2-year loss of $43 million per year represents a 22-percent-per-year loss for 2 years.

Because the occurrence of a large oil spill (e.g., 200,000 bbl) would preclude any knowledge of what the commercial fishery would have been worth (due to closures), the value of the commercial fishery at the time of the 200,000-bbl oil spill is assumed to be the estimated average annual value of the gulf commercial fishery. In terms of the estimated average annual value (about $125 million), a 2-year loss of about $9 million per year represents a 7-percent-per-year loss for 2 years, whereas a 2-year loss of about $43 million per year represents a 34-percent-per-year loss for 2 years. These estimates are the same as for large spill because, as indicated above, any large oil spill is large enough to close the same amount of commercial fishery within the sale area. However, if it is assumed that the oil from the 200,000-bbl oil spill also moves outside and northwest of the sale area, additional closures are expected from Prince William Sound to Resurrection Bay. It is estimated that these additional closures would further reduce the value of gulf commercial fisheries (excluding Kodiak and Cook Inlet) by about 30 percent for 2 years. Hence, estimated gulf commercial fishing losses due to the 200,000-bbl oil spill are estimated to range between $45 million (7+30 = 37%) and $80 million (34+30 = 64%) per year for 2 years following the spill.

Thus, based on EVOS loss estimates and the estimated annual value of the northeastern gulf commercial fishery, the 200,000-bbl oil spill could result in an economic loss to the northeastern gulf commercial fishing industry of 12 to 57 percent per year for 2 years (within the sale area). However, in terms of the estimated average annual value of the northeastern gulf commercial fishery, the 200,000-bbl oil spill is more likely to result in a loss of about 7 to 34 percent per year for 2 years within the sale area. Additional closures northwest of the sale area are estimated to increase this loss to between 37 and 64 percent per year for 2 years following the spill. Compensation to the commercial-fishing industry for participating in the cleanup of an oil spill is likely to exceed these economic losses by several orders of magnitude.

Conclusion: Based on the assumptions discussed in the text, adjusted EVOS loss estimates, and the average annual value of the Gulf of Alaska commercial fishery, the 200,000-bbl oil spill is estimated to result in economic losses to the gulf commercial-fishing industry ranging from 37 to 64 percent per year for 2 years following the spill.

11. Subsistence-Harvest Patterns: This analysis assumes that a 200,000-bbl tanker oil spill occurs offshore Cape Fairweather along Tanker Segment T6 during the summer with onshore winds (Fig. IV.I-1). Within 10 days the spill is estimated to have swept over a discontinuous area of 1,738 km (Table IV.I-1), and a portion of the spill is estimated to have contacted coastline habitats from Yakutat Bay westward to Kayak Island, as shown in Figure IV.I-1. Within 30 days the 200,000-bbl oil spill is estimated to contact the entire coastline associated with the Yakutat and Cordova subsistence-harvest areas.

The effects on subsistence-harvest patterns would be comparable to the effects from the EVOS of 1989, because both tanker spills would have occurred at similar times and would be of approximately the same size. The primary difference between the two incidents is in the geography of the spills, which makes Yakutat more instantaneously subject to contact. The annual round of harvest activities for Yakutat indicates that some harvests, such as for harbor seal, salmon, and marine invertebrates, could have begun. The instantaneous nature of the event would not permit opportunistic "stocking up" of available resources. Using the EVOS experience as a gauge, effects on subsistence-harvest patterns for the residents of Yakutat and Cordova—especially for intertidal resources and some fish species—would be expected to last for at least 4 years.

Conclusion: Subsistence harvests in the 200,000-bbl-spill case would be reduced or substantially altered by as much as 80 percent in Yakutat and Cordova for at least 1 year and, to a lesser extent, for selected subsistence resources 3 to 4 years beyond.

12. Sociocultural Systems: This analysis assumes that a 200,000-bbl tanker oil spill occurs offshore Cape Fairweather along Tanker Segment T6 during the summer with onshore winds (Fig. IV.I-1). Within 10 days the spill is estimated to have swept over a discontinuous area of 1,738 km (Table IV.I-1), and a portion of the spill is estimated to have contacted coastline habitats from Yakutat Bay westward to Kayak Island, as shown in Figure IV.I-1. Within 30 days the 200,000-bbl oil spill is estimated to contact the entire coastline associated with the Yakutat and Cordova subsistence-harvest areas.

The location of the 200,000-bbl spill off Cape Fairweather suggests that spill effects on Yakutat would be instantaneous, with little time to prepare, and could be expected to last at least 4 years. Individuals and communities that depend on income from commercial fisheries would experience stress and anxiety from debt burden, income shortfalls, litigation, and fear for the future should the fisheries they participate in or depend on in other capacities be shortened or terminated due to the accidental spill.

Considerable stress and anxiety also would be expected over the loss of subsistence resources, contamination of habitat, fear of the health effects of eating contaminated wild foods, and the need to depend on the knowledge of others about environmental contamination (Maganak, 1990; Fall, 1992; McMullen, 1993). Individuals and the communities of Yakutat and Cordova would be increasingly stressed during the time needed to modify subsistence-harvest patterns by selectively changing harvest areas, if available. Associated culturally significant activities, such as the organization of subsistence activities among kinship and friendship groups and the relationships among those that customarily process and share subsistence harvests, would be modified or would decline as well.

The 200,000-bbl-spill case also would be expected to affect individuals and institutions in ways similar to the EVOS experience. As shown by the EVOS, some individuals found a new arena for pre-existing personal and political conflict, especially over the dispensation of money and contracts. In the smaller communities, cleanup work produced a redistribution of resources, creating new schisms in the community (Richards, undated). Many members of small communities were on the road to sobriety prior to the spill; but after the spill some people began drinking again, producing the re-emergence of numerous alcohol-related problems, such as child abuse, domestic violence, and accidents, that were there before (Richards, undated).

Institutional effects included additional burdens being placed on local government, disruption of existing community plans and programs, strain on local officials, difficulties dealing with the spiller, community conflict, disruptions of customary habits and patterns of behavior, emotional effects and stress-related disorders, confronting environmental degradation and death, and violation of community values (Endter-Wada, 1992). Postspill stress resulted from this seeming loss of control over individual and institutional environments as well as from secondary episodes such as litigation, which produced secrecy over information, uncertainty over outcomes, and community segmentation (Smythe, 1990; Picou and Gill, 1993). Attempts to mitigate effects met with a higher priority placed on concerns over litigation and a reluctance to intervene with people for fear it might benefit adversaries in legal battles (Richards, undated).

Conclusion: Sociocultural systems in the communities of Yakutat and Cordova are expected to undergo severe individual, social, and institutional stress and disruption in

542

the year of the 200,000-bbl spill that would last at least 4 years thereafter.

13. Archaeological Resources: The 200,000-bbl oil spill would affect archaeological resources by creating surface-disturbing activities resulting from emergency shoreline treatment. Following the EVOS, Exxon developed and funded a Cultural Resource Program to ensure that potential effects on archaeological sites were minimized during shoreline treatment (Betts, 1991). This program involved a team of archaeologists who performed reconnaissance surveys of the affected beach segments, reviewed proposed oil-spill treatment, and monitored treatment. As a result of the coastline surveys, hundreds of archaeological sites were discovered, recorded, and verified. This resulted in the most comprehensive archaeological record of Alaskan coastline ever documented.

Although a number of sites in the EVOS area were vandalized during the 1989 cleanup season, the large number of Exxon and government-agency archaeologists visible in the field may have lessened the amount of site vandalism that may have occurred (Mobley, 1990).

The Dekin study (1993) found that small amounts of petroleum hydrocarbons may occur in most archaeological sites within the study area. This suggests a low-level petroleum contamination that had not previously been suspected. Since the researchers found no evidence of extensive soil contamination from a single definable source (i.e., the oil spilled from the *Exxon Valdez*), they " now add the continuing contamination of soils from small and large petroleum spills in areas where present and past land use coincide" (Dekin, 1993). Vandalism was found to have a significant effect on archaeological site integrity but could not be tied directly to the oil spill (Dekin, 1993).

Conclusion: The expected effect on onshore archaeological resources from a large oil spill is uncertain, but data from the EVOS indicate that less than 3 percent of the resources within a spill area would be significantly affected.

14. Recreation and Tourism: This analysis assumes that a 200,000-bbl tanker spill occurs approximately 60 km due east of Glacier Bay National Park and Preserve between Dry Bay and Lituya Bay during the summer. Within 10 days the spill is estimated to contact the coastal areas of Wrangell-Saint Elias National Park and Preserve and the Tongass National Forest adjacent to Yakutat Bay. Within 30 days the oil spill would move north and west along the Gulf of Alaska in the Alaska Current and Alaska Coastal Current and contact coastal areas in Prince William Sound and the Kenai Fjords National Park. The spill also would contact Glacier Bay National Park and Preserve within 30 days.

Recreation and tourism activities in coastal areas contacted by the spill would in all likelihood be precluded until spill-cleanup operations and natural processes restored the sites to a relatively natural condition. Oil-spill-cleanup activity would disturb resources in the area 200 m inward from the waterline, as happened with the EVOS oil-spill cleanup.

The effect of a large spill on Prince William Sound's tourist industry would be very similar to that of the EVOS. The immediate effect of a large oil spill contacting the northern coast of the Gulf of Alaska would be the cancellation of tourist plans to visit the area contacted by the spill. The biggest effect would be felt by small charter-boat, lodge, and sport-fishing operations that normally would get many of their bookings just before the summer season. Lodges and fishing operations in the Yakutat area would probably suffer the largest economic losses as a result of the spill. Other tourist attractions along the Gulf of Alaska and areas adjacent to the area of spill contact could expect a decline in the number of bookings for the summer. Major cruise lines, which require deposits from customers, would probably be least affected by the oil spill. Major economic losses could be expected for the tourist season following the spill, however, tourist levels would be expected to rebound to prespill levels 1 year after the spill, as was the experience with the EVOS.

Conclusion: The 200,000-bbl oil spill would preclude recreation and tourism activities in the coastal areas of the Wrangell-Saint Elias National Park and Preserve, Tongass National Forest, Prince William Sound, and Glacier Bay National Park and Preserve until spill-cleanup operations and natural processes restored the sites. Major economic losses could be expected for the tourist industry following the spill, with small charter-boat, lodge, and sportfishing operations in the Yakutat area being the hardest hit. However, tourist levels would be expected to rebound to prespill levels 1 year after the spill.

15. Land Use Plans and Coastal Management Programs: In the event of a 200,000-bbl oil spill, greater effects would be experienced by most biological resources in coastal environments and intertidal areas; by subsistence users; and by cultural and archaeological resources. Water quality would exceed the acute chronic criterion for >1 month. Because these greater levels of effects are perpetrated by an accidental oil spill along a transportation route that is not inherently more dangerous than other potential routes, most Statewide and district policies would apply here

Statewide standards and district policies related to coastal development; geophysical hazards; energy facilities; transportation and utilities; and historic, prehistoric, and archaeological resources can be applied better when an actual development is proposed. Nothing in the scenario is inherently in conflict with these policies. The broader Statewide standards and district policies related to subsistence; habitat; and air, land, and water quality can be applied more easily with the information available at the lease-sale stage.

The greater level of effects identified in above Sections IV.I.1 through IV.I.14 of this section do not translate into greater potential for conflict with these Statewide standards and district policies for the reason stated above—the spill that is the source of the effects is accidental and does not reflect a particular siting decision for transporting oil to market.

Regardless of the method used for transshipment, all oil leaving the State of Alaska travels by tanker. Mitigating measures that reinforce MMS regulations related to oil-spill-contingency (OSCP's) plans and regulations that ensure safe drilling operations ameliorate potential conflict on the drilling site; but in this instance the spill occurs while the product is being transported to market. Tanker traffic is not controlled by MMS; however, OSCP's are required for tankers and would need to be in place before the oil was transported.

Conclusion: Conflicts with the Statewide standards and Yakutat District policies related to site-specific decisions are not inherently in conflict with the scenario. Effects of a 200,000-bbl spill could affect the habitat; subsistence; and air-, land-, and water-quality standards of the ACMP and the Yakutat District plan.

Anderson, C.M. 1994. Telephone Conversation of Nov. 21, 1994, From Caryn Smith, Oceanographer, USDOI, MMS, Alaska OCS Region, to Cheryl M. Anderson, USDOI, MMS, TAG, Herndon, VA.; Subject: Crude Oil-Spills Sizes on the OCS.

Betts, R.C., C.B. Wooley, C.M. Mobley, J.D. Haggarty, and A. Crowell. 1991. Site Protection and Oil Spill Treatment at SEL-188, an Archaeological Site in Kenai Fjords National Park, Alaska. Anchorage, AK: Exxon Company U.S.A., 79 pp. plus bibliography.

Calkins, D.G. and E. Becker. 1990. Assessment of Injury to Sea Lions in Prince William Sound and the Gulf of Alaska, Preliminary Status Report for April Through December 1990. *In*: *Exxon Valdez* Oil Spill Natural Resource Damage Assessment. NRDA Marine mammal Study No. 4, Unpublished Report. Juneau, AK: State of Alaska, Dept. of Fish and Game.

Carls, M.G., L. Holland, M. Larsen, J.L. Lum, D. Mortensen, S.Y. Wang, and A.C. Wertheimer. 1993. Effects of Oil Contaminated Food on the Growth of Juvenile Pink Salmon *Oncorhynchus Gorbuscha*. *In*: *Exxon Valdez* Oil Spill Symposium. Feb. 2-5, 1993, Anchorage, AK. Anchorage, AK.

Cohen, M.J. 1993. The Economic Impacts of the *Exxon Valdez* Oil Spill on Southcentral Alaska's Commercial Fishing Industry. *In*: *Exxon Valdez* Oil Spill Symposium Abstract Book. B. Spies, L.J. Evans, B. Wright, M. Leonard, and C. Holba, eds. and comps. Feb. 2-5, 1993, Anchorage, AK: *Exxon Valdez* Oil Spill Trustee Council, University of Alaska Sea Grant College Program, and American Fisheries Society, Alaska Chapter, pp. 227-30.

Dahlheim, M.E. and T.R. Loughlin. 1990. Effects of the *Exxon Valdez* Oil Spill on the Distribution and Abundance of Humpback Whales in Prince William Sound, Southeast Alaska, and the Kodiak Archipelago. *In*: *Exxon Valdez* Oil Spill Natural Resource Damage Assessment. NRDA Marine Mammal Study No. 1, Unpublished Report. Seattle, WA: USDOC, NOAA.

Dekin, A.A., Jr. 1993. Exxon Valdez Oil Spill Archaeological Damage Assessment, Management Summary, Final Report. Contract No. 53-0109-1-00325. Juneau, AK: USDA, Forest Service.

Endter-Wada, J. 1992. Social Economic and Subsistence Effects of the *Exxon Valdez* Oil Spill on the Kodiak Region. *In*: Conference Proceedings, Alaska OCS Region, Fourth Information Transfer Meeting. Jan. 28-30, 1992, Anchorage, AK. OCS Study, MMS 92-0046. Anchorage, AK: USDOI, MMS, AK OCS Region, pp. 283-88.

Evans, D.D. 1988. Combustion of Oil Spills on Water. *In*: Technology Assessment and Research Program for Offshore Minerals Operations. OCS Study, MMS 86-0057. Washington, DC: USDOI, MMS pp. 169-177.

Fall, J.A. 1992. Changes in Subsistence Uses of Fish and Wildlife Resources in 15 Alaska Native Villages Following the *Exxon Valdez* Oil Spill. *In*: Conference Proceedings, Alaska OCS Region, Fourth Information Transfer Meeting, Jan. 28-30, 1992, Anchorage, Ak. Anchorage, AK: USDOI, MMS, AK OCS Region, pp. 261-70.

Ford, R.G. 1985. Oil Slick Sizes and Length of Coastline Affected: A Literature Survey and Statistical Analysis. Contract No. 14-12-0001-30224. Los Angeles, CA: USDOI, MMS, Pacific OCS Region, 34 pp.

Ford, R.G., M.L. Bonnell, D.H. Varoujean, G.W. Page, B.E. Sharp, D. Heinemann, and J.L. Casey. 1991. Assessment of Direct Seabird Mortality in Prince William Sound and the Western Gulf of Alaska Resulting From the *Exxon Valdez* Oil Spill. Portland, OR: Ecological Consulting, Inc., 153 pp.

Gould, P.J., D.J. Forsell, and C.J. Lensink. 1982. Pelagic Distribution and Abundance of Seabirds in the Gulf of Alaska and Eastern Bering Sea. FWS/OBS 82/48. Anchorage, AK: USDOI, FWS, Biological Services Program, and USDOI, BLM, 294 pp.

Gundlach, E.R., P.D. Boehm, M. Marchand, R.M. Atlas, D.M. Ward, and D.A. Wolfe. 1983. The Fate of AMOCO Cadiz Oil. *Science* 221:122-129.

Kineman, J.J., R. Elmgren, and S. Hansson, eds. 1980. The *Tsesis* Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978). Boulder, CO: USDOC, NOAA, OMPA, 296 pp.

Kirstein, B.E., J.R. Payne, and R.T. Redding. 1983. Oil-Weathering Computer Program Users' Manual. Multivariate Analysis of Petroleum Weathering in the Marine Environment Sub Arctic. Partial Final Report. Anchorage, AK: USDOC, NOAA, and USDOI, MMS, 88 pp.

Laevastu, T., R. Marasco, N. Bax, T. Honkalehto, R. Fredin, F. Fukuhara, A. Gallagher, J. Ingraham, P. Livingston, R. Miyahara, and N. Pola. 1985. Evaluation of the Effects of Oil Development on the Commercial Fisheries on the Eastern Bering Sea. OCS Study, MMS 85-107. OCSEAP Final Reports of Principal Investigators, Vol. 36, Part 1 (Dec. 1985). Anchorage, AK: USDOC, NOAA, and USDOI, MMS, pp. 1-48.

Malins, D.C. 1977. Biotransformation of Petroleum Hydrocarbons in Marine Organisms Indigenous to the Arctic and Subarctic. *In*: Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms, Proceedings of a Symposium. D.A. Wolfe, ed. Nov. 10-12, 1976, Seattle, WA. New York: Pergamon Press. Sponsored by USDOC, NOAA, and USEPA.

McMullen, E. 1993. Testimony Dated Mar. 24, 1993, of Elenore McMullen, Chief, Native Village of Port Graham, Alaska, Before the U.S. House of Representatives' Committee on Merchant Marine and Fisheries. Washington, DC: U.S. Government Printing Office.

Mobley, C.M., J.C. Haggarty, C.J. Utermohle, M. Eldridge, R.E. Reanier, A. Crowell, B.A. Ream, D.R. Yesner, J.M. Erlandson, P.E. Buck, W.B. Workman, and K. W. Workman. 1990. The 1989 *Exxon Valdez* Cultural Resource Program. Anchorage, AK: Exxon Shipping Company and Exxon Company, USA, 300 pp.

National Research Council. 1985. *Oil in the Sea: Inputs, Fates, and Effects.* Washington, DC: National Academy Press. 601 pp.

Payne, J.R., B.E. Kirstein, G.D. Jr. McNabb, J.L. Lambach, R. Redding, R.E. Jordan, W. Horn, C de Oliveria, G.S. Smith, D.M. Baxter, and R Gaegel. 1984. Multivariate Analysis of Petroleum Weathering in the Marine Environment - Sub Arctic. Vol I - Technical Results. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators, Vol 21 (Feb. 1984). Juneau, AK: USDOC, NOAA, and USDOI, MMS, 686 pp.

Payne, J.R., B.E. Kirstein, G.D. Jr. McNabb, J.L. Lambach, R. Redding, R.E. Jordan, W. Horn, C de Oliveria, G.S. Smith, D.M. Baxter, and R Gaegel. 1984. Multivariate Analysis of Petroleum Weathering in the Marine Environment - Sub Arctic. Vol II - Appendices. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators, Vol 21 (Feb. 1984). Juneau, AK: USDOC, NOAA, and USDOI, MMS, pp. 1-56.

Payne, J.R., G.D. McNabb, L.E. Hachmeister, B.E. Kirstein, J.R. Clayton, C.R. Phillips, R.T. Redding, C.L. Clary, G.S. Smith, and G.H. Farmer. 1987. Development of a Predictive Model for Weathering of Oil in the Presence of Sea Ice. OCS Study, MMS 89-0003. OCSEAP Final Reports of Principal Investigators, Vol. 59 (Nov. 1988). Anchorage, AK: USDOC, NOAA, and USDOI, MMS, pp. 147-465.

Piatt, J.F., C.J. Lensink, W. Butler, M. Kendziorek, and D.R. Nysewander. 1990. Immediate Impact of the *Exxon Valdez* Oil Spill on Marine Birds. *The Auk* 107:387-397.

Picou, J.S. and D.A. Gill. 1993. Long-Term Social Psychological Impacts of the *Exxon Valdez* Oil Spill. *In*: *Exxon Valdez* Oil Spill Symposium Abstract Book, B. Spies, L.J. Evans, B. Wright, M. Leonard, and C. Holba, eds. and comps., Feb. 2-5, 1993, Anchorage, Ak. Anchorage, AK: *Exxon Valdez* Oil Spill Trustee Council, University of Alaska, Sea Grant College Program, and American Fisheries Society, Alaska Chapter, pp. 223-26.

Richards, B. No Date. Mitigating Psychological and Social Impacts of the *Exxon Valdez* Spill on Small Villages. Paper presented at: SFAA Meetings, Disaster Research Conference.

Sheppard, E.P. and P.E. Georghiou. 1981. The Mutagenicity of Prudhoe Bay Crude Oil and Its Burn Residues. *In*: Proceedings of the Fourth Arctic Marine Oilspill Program Technical Seminar, Jun. 16-19, 1981, Edmonton, Alberta, Canada. Ottawa, Ontario: Environmental Protection Service, Environmental Emergency Branch, pp. 195-213.

Smythe, C.W. 1990. In the Second Year: Continuing Village Impacts of the *Exxon Valdez* Oil Spill. *In*: 1990 Alaska Science Conference Proceedings of the 41st Arctic Science Conference: Circumpolar Perspectives. Oct. 8-10, 1990, Anchorage, AK. Anchorage, AK: American Association for the Advancement of Science, Alaska Division.

Wertheimer, A.C., A.G. Celewycz, M.G. Carls, and M.V. Sturdevant. 1993. The Impacts of the *Exxon Valdez* Oil Spill on Juvenile Pink and Chum Salmon and Their Prey in Nearshore Marine Habitats. *In*: *Exxon Valdez* Oil Spill Symposium, B. Spies, L.J. Evans, B. Wright, M. Lenard, and C. Holba, eds. and comps. *Feb 2-5*, 1993, Anchorage, AK. Anchorage, AK: Exxon Valdez Trustee Council, University of Alaska, Sea Grant College Program and American Fisheries Society, Alaska Chapter.

Wolfe, D.A., M.J. Hameedi, J.A. Galt, G. Watabayashi, J.W. Short, C.E. O'Clair, S. Rice, J. Michel, J.R. Payne, J.F. Braddock, S. Hanna, and D.M. Sale. 1993. Fate of the Oil Spilled From the T/V *Exxon Valdez* in Prince William Sound, Alaska. *In*: *Exxon Valdez* Oil Spill Symposium Abstract Book, B. Spies, L.J. Evans, B. Wright, M. Leonard, and C. Holba, eds and comps., Feb. 2-5, 1993, Anchorage, Ak. Anchorage, AK: *Exxon Valdez* Oil Spill Trustees, University of Alaska, Sea Grant College Program, and American Fisheries Society, Alaska Chapter, pp. 6-9.

Wolfe, D.A., M.J. Hameedi, J.A. Galt, G. Watabayashi, J. Short, O'Claire, S. Rice, J. Michel, J.R. Payne, J. Braddock, S. Hanna, and D. Sale. 1994. The Fate of the Oil Spilled From the *Exxon Valdez*. *Environmental Science and Technology* 28(13):561A-568A.

APPENDIX C

Endangered and Threatened Species Consultation

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
ALASKA STATE OFFICE
222 W. 7th Avenue, #13
ANCHORAGE, ALASKA 99513-7599

6840 NPRA (931)

MAY 6 1997

Memorandum

To: Regional Director, U.S. Fish and Wildlife Service

From: State Director

Subject: Endangered Species - Proposed Oil and Gas Lease Sale in the National Petroleum Reserve-Alaska (NPR-A)

The Bureau of Land Management (BLM) has initiated an Integrated Activity Plan/Environmental Impact Statement (IAP/EIS) to update its management strategy for the northeast portion of NPR-A (see attached Notice of Intent, which includes a map of the area). The IAP/EIS will address the full range of BLM's management responsibilities in the planning area, including oil and gas leasing, wildlife protection, subsistence, and recreation. The plan will be finalized in the summer of 1998 and a Record of Decision is anticipated at the end of July, 1998. If oil and gas leasing results from the IAP/EIS, the lease sale will probably take place no sooner than September, 1998.

In accordance with the Endangered Species Act, Section 7, regulations governing interagency cooperation, we are providing a notification of the listed and proposed species and critical habitat that will be included in the biological evaluation.

It is our understanding that there are no designated or proposed critical habitats for any listed or proposed species potentially affected by oil and gas exploration activities in the proposed lease sale area. In our biological evaluation, we will review the following listed and proposed species that may be present in the proposed lease area.

Common Name	Scientific Name	Status
Spectacled eider	*Somateria fischeri*	threatened
Steller's eider	*Polysticta stelleri*	proposed threatened

We do not plan to include the Arctic peregrine falcon, *Falco peregrinus tundrius*, in the biological evaluation since it was delisted on October 5, 1994, unless we are otherwise advised by your agency.

In the event that the IAP/EIS results in an oil and gas lease sale, analysis of potential effects on species that occur along the expected oil transport corridor is required. Analysis of the potential effects of several species on the likely transportation route to U.S. ports along the West Coast were included in biological evaluations prepared by the Minerals Management Service (MMS) for Cook Inlet Lease Sale 149 and Gulf of Alaska-Yakutat Lease Sale 158. Analysis of potential effects on several species that may occur along the expected oil transport corridor to ports in the Far East was included in MMS's Final Environmental Impact Statement (FEIS) for Oil and Gas Lease Sale 144. The oil transport scenario for any NPR-A sale will likely remain the same, so evaluations of species along the transportation corridors are incorporated by reference from the biological evaluations for Sale 149 and Sale 158 and the FEIS for Sale 144.

Please review our list and notify us of your concurrence or revisions and of any new information concerning these species in relation to the planning area. To facilitate the review, we have provided a copy of this letter to your Anchorage Ecological Services Field Office. Upon receipt of your reply, preparation of the biological evaluation reviewing potential effects of the proposed action will begin. The MMS personnel, in cooperation with BLM's staff, will be preparing the biological evaluation for the Section 7 consultation. If you have any questions concerning this proposed action, please contact MMS biologists Joel Hubbard at (907) 271-6670 or Frank Wendling at (907) 271-6510.

We look forward to working with you and your staff in protecting and conserving endangered and threatened species.

/s/ Tom Allen

Attachment
    Notice of Intent (3 pp)

AK931:JPayne:cla:x5477:5/2/97:t&efws2.wpd

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
ALASKA STATE OFFICE
222 W. 7th Avenue, #13
ANCHORAGE, ALASKA 99513-7599

6840 NPRA (931)

MAY 6 1997

Mr. Steven Pennoyer
Director, Alaska Region
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

Dear Mr. Pennoyer:

The Bureau of Land Management (BLM) has initiated an Integrated Activity Plan/Environmental Impact Statement (IAP/EIS) to update its management strategy for the northeast portion of NPR-A (see attached Notice of Intent, which includes a map of the area). The IAP/EIS will address the full range of BLM's management responsibilities in the planning area, including oil and gas leasing, wildlife protection, subsistence, and recreation. The plan will be finalized in the summer of 1998 and a Record of Decision is anticipated at the end of July, 1998. If oil and gas leasing results from the IAP/EIS, the lease sale will probably take place no sooner than September, 1998.

In accordance with the Endangered Species Act, Section 7, regulations governing interagency cooperation, we are contacting your agency requesting notification of any listed or proposed species or critical habitat that may be present in or affected by oil and gas exploration activities in the proposed lease sale area that should be included in the biological evaluation.

In the event that the IAP/EIS results in an oil and gas lease sale, analysis of potential effects on species that occur along the expected oil transport corridor is required. Analysis of the potential effects of several species on the likely transportation route to U.S. ports along the West Coast were included in biological evaluations prepared by the Minerals Management Service (MMS) for Cook Inlet Lease Sale 149 and Gulf of Alaska-Yakutat Lease Sale 158. Analysis of potential effects on several species that may occur along the expected oil transport corridor to ports in the Far East was included in MMS's Final Environmental Impact Statement (FEIS) for Oil and Gas Lease Sale 144. The oil transport scenario for any NPR-A sale will likely remain the same, so evaluations of species along the transportation corridors are incorporated by reference from the biological evaluations for Sale 149 and Sale 158 and the FEIS for Sale 144.

To facilitate the review, we have provided a copy of this letter to your Anchorage field office. Upon receipt of your reply, preparation of the biological evaluation reviewing potential effects of the proposed action will begin. The MMS personnel, in cooperation with BLM's staff, will be preparing the biological evaluation for the Section 7 consultation. If you have any questions concerning this proposed action, please contact MMS biologists Frank Wendling at (907) 271-6510 or Joel Hubbard at (907) 271-6670.

We look forward to working with you and your staff in protecting and conserving endangered and threatened species.

Sincerely,

/s/ Tom Allen

State Director

Enclosure
    Notice of Intent (3 pp)

cc: Anchorage Ecological Field Office

AK931:JPayne:cla:X5477:5/2/97:t4enmfs2.wpd

UNITED STATES DEPARTMENT OF COMMERC
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

97 MAY 30 AM 10:20
[illegible] SO 950

May 23, 1997

930
ATTN: GENE T.

T Allen
6/1/97

Tom Allen
State Director
Bureau of Land Management
222 West 7th Avenue, #13
Anchorage, Alaska 99513-7599

Dear Mr. Allen:

Thank you for your letter requesting a list of Threatened or Endangered species occurring in the area associated with National Petroleum Reserve-Alaska. The National Marine Fisheries Service is responsible for certain marine species listed under the Endangered Species Act of 1972, as amended (ESA). Of these, the bowhead whale Balaena mysticetus, is found within the waters of the Beaufort Sea off the Alaska coast. Several additional listed species occur in the Gulf of Alaska and along the vessel transportation routes to U.S. ports along the West Coast. This letter provides a list of the ESA-listed species that occur in Alaska. We suggest that you contact the NMFS Northwest Regional Office and the NMFS Southwest Regional Office for additional species that occur in the waters of Washington, Oregon and California. The ESA-listed species that are present in Alaskan waters are as follows:

Common Name	Scientific Name	Status
Bowhead whale	Balaena mysticetus	Endangered
Northern right whale	Eubalaena glacialis	Endangered
Fin whale	Balaenoptera physalus	Endangered
Humpback whale	Megaptera novaeangliae	Endangered
Sperm whale	Physeter macrocephalus	Endangered
Sei whale	Balaenoptera borealis	Endangered
Blue whale	Balaenoptera musculus	Endangered
Steller sea lion	Eumetopias jubatus	
Western stock		Endangered*
Eastern stock		Threatened*
Snake River sockeye salmon	Oncorhynchus nerka	Endangered

Snake River Spring/Summer Chinook Salmon
Oncorhynchus tshawytscha Threatened
Snake River Fall Chinook Salmon
Oncorhynchus tshawytscha Threatened

Under Section 7 of the ESA, a federal agency is required to consult with the Secretary of Commerce regarding the presence of these species or their designated critical habitat. If this presence is identified, the agency must then determine if the activity may affect these animals or habitats. If it finds the action would not affect these concerns, no further consultation is required. Otherwise, the action agency should notify NMFS of its findings and request consultation under the Act.

We hope this information is useful in fulfilling the requirements of the ESA. Please direct any questions you may have to Brad Smith in our Anchorage office at (907)271-5006.

Sincerely,

Steven T. Zimmerman Ph.D.
Chief, Protected Resources
Management Division

*The Steller sea lion is listed as an endangered species for stocks west of 144° W longitude and as a threatened species to the east. Rookeries, major haul outs, and special foraging areas have been designated as critical habitat for this species. These sites are identified in 50 CFR 226.12.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
ENVIRONMENTAL & TECHNICAL SERVICES DIVISION
525 NE Oregon Street
PORTLAND, OREGON 97232-2737

June 10, 1997 F/NWO3

Mr. Frank Wendling
Minerals Management Service
Alaska OCS Region, Leasing and Environment Office
949 E. 36th Avenue, Room 300
Anchorage, Alaska 99508-4363

Re: Species List Request for the National Petroleum Reserve-Alaska

Dear Mr. Wendling:

The National Marine Fisheries Service (NMFS) has reviewed your June 9, 1997, facsimile to Ben Meyer requesting a list of threatened and endangered species for an Environemntal Impact Statement for the national Petroleum Reserve - Alaska.

We have enclosed lists of those anadromous fish species that are listed as threatened or endangered under the Endangered Species Act (ESA), those that are proposed for listing, and those that are candidates for listing. This inventory includes only anadromous species under NMFS' jurisdiction that occur in the Pacific Northwest. The U.S. Fish and Wildlife Service should be contacted regarding the presence of species falling under its jurisdiction.

Available information indicates that the following listed salmon species may occur in the project area: Snake River Sockeye Salmon, (*Oncorhynchus nerka*); Snake River Fall Chinook Salmon, (*O. tshawytscha*); Snake River Spring/Summer Chinook Salmon (*O. tshawytscha*); S. Oregon/N. California Coast Coho Salmon (*O. kisutch*). The following proposed species may also occur in the project area: Klamath Mountains Province Steelhead (*O. mykiss*); Lower Columbia River Steelhead (*O. mykiss*); Upper Columbia River Steelhead (*O. mykiss*); Oregon Coast Steelhead (*O. mykiss*); and Snake River Basin Steelhead (*O. mykiss*).

This letter constitutes the required notification of the presence of any Federally listed threatened or endangered species or critical habitat under NMFS' jurisdiction in the permit area that may be affected by the proposed project (Appendix A to Part 330, Section C.13(5)(i)).

If you have any further questions, please contact Ben Meyer of my staff at (503) 230-5425.

Sincerely,

Ben Meyer

for Elizabeth Holmes Gaar, Chief
Habitat Conservation Division

Enclosure

ENDANGERED, THREATENED, AND PROPOSED SPECIES UNDER NATIONAL MARINE FISHERIES SERVICE JURISDICTION

Listed Species

Snake River Sockeye Salmon	*Oncorhynchus nerka*
Snake River Fall Chinook Salmon	*O. tshawytscha*
Snake River Spring/Summer Chinook Salmon	*O. tshawytscha*
Umpqua River Cutthroat Trout	*O. clarki clarki*
S. Oregon/N. California Coast Coho Salmon	*O. kisutch*

Proposed for Listing

(The following ESUs)

Steelhead	*O. mykiss*
Klamath Mountains Province	
Lower Columbia River	
Upper Columbia River	
Oregon Coast	
Snake River Basin	

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Alaska Outer Continental Shelf Region
949 E. 36th Avenue, Room 603
Anchorage, Alaska 99508-4302

IN REPLY REFER TO

JUN 12 1997

Dr. William T. Hogarth
Regional Administrator
National Marine Fisheries Service
Southwest Regional Center
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

Dear Dr. Hogarth:

The Minerals Management Service (MMS) is jointly preparing an Integrated Activity Plan/ Environmental Impact Statement (IAP/EIS) for the Bureau of Land Management for the northeast portion of the National Petroleum Reserve, Alaska, which is located on the North Slope of Alaska. One of the proposed activities could be an oil and gas lease sale. Any oil discovered as a result of a lease sale and subsequently produced will likely be transported by pipeline from the planning area to the Trans-Alaska Pipeline System and subsequently transported by tanker to ports in the lower 48 states.

In accordance with the Endangered Species Act Section 7 regulations governing interagency cooperation, and at the recommendation from the National Marine Fisheries Service (NMFS), Alaska Region, we are contacting your agency requesting notification of any listed or proposed species or critical habitat that may be affected as a result of tankering oil south to ports in Washington, Oregon, and California. MMS has previously addressed in earlier EIS's and Biological Evaluations various endangered and threatened species including fin, humpback, sei, blue, northern right, and sperm whales, Steller's sea lion, Guadalupe fur seal, and green, leatherback, loggerhead, and Pacific ridley sea turtles.

On June 9, 1997, Mr. Frank Wendling from this office contacted Mr. Craig Wingert in your office by telephone and faxed to him a copy of our original species list letter dated May 6, 1997, sent to the NMFS, Alaska Region, and a copy of their response dated May 23, 1997. This letter confirms the request for species information requested by the telephone call and the fax. If you have any questions concerning this proposed action, please contact Frank Wendling at (907) 271-6510.

We look forward to working with you in our shared goal to protect threatened and endangered species.

Sincerely,

John Goll

John Goll
Regional Director

cc:
Mr. Craig Wingert
Mr. Ben Meyer, NMFS
Dr. Steve Zimmerman, NMFS
Mr. Tom Allen, BLM

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Alaska Outer Continental Shelf Region
949 E. 36th Avenue, Room 603
Anchorage, Alaska 99508-4302

IN REPLY REFER TO

JUN 12 1997

Ms. Elizabeth Gaar
Chief, Habitat Conservation Division
National Marine Fisheries Service
525 Northeast Oregon Street, Suite 500
Portland, Oregon 97232-2737

Dear Ms. Gaar:

The Minerals Management Service (MMS) is jointly preparing an Integrated Activity Plan/ Environmental Impact Statement (IAP/EIS) for the Bureau of Land Management for the northeast portion of the National Petroleum Reserve, Alaska, which is located on the North Slope of Alaska. One of the proposed activities could be an oil and gas lease sale. Any oil discovered as a result of a lease sale and subsequently produced will likely be transported by pipeline from the planning area to the Trans-Alaska Pipeline System and subsequently transported by tanker to ports in the lower 48 states.

In accordance with the Endangered Species Act Section 7 regulations governing interagency cooperation, and at the recommendation from the National Marine Fisheries Service (NMFS), Alaska Region, we are contacting your agency requesting notification of any listed or proposed species or critical habitat that may be affected as a result of tankering oil south to ports in Washington, Oregon, and California. MMS has previously addressed in earlier EIS's and Biological Evaluations various endangered and threatened species including fin, humpback, sei, blue, northern right, and sperm whales, Steller's sea lion, Guadalupe fur seal, and green, leatherback, loggerhead, and Pacific ridley sea turtles.

On June 9, 1997, Mr. Frank Wendling from this office contacted Mr. Ben Meyer in your office by telephone and faxed to him a copy of our original species list letter dated May 6, 1997, sent to the NMFS, Alaska Region, and a copy of their response dated May 23, 1997. This letter confirms the request for species information requested by the telephone call and the facsimile. We received your response by fax on June 10, 1997. Thank you for your very prompt response. If you have any questions concerning this proposed action, please contact Frank Wendling at (907) 271-6510.

We look forward to working with you in our shared goal to protect threatened and endangered species.

Sincerely,

John Goll

John Goll
Regional Director

cc: Mr. Ben Meyer
Mr. Craig Wingert, NMFS
Dr. Steve Zimmerman, NMFS
Mr. Tom Allen, BLM

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213
TEL (310) 980-4000; FAX (310) 980-4018

JUN 26 1997 F/SW031:RCW

RECEIVED
JUN 30 1997
REGIONAL DIRECTOR, ALASKA OCS
Minerals Management Service
ANCHORAGE, ALASKA

John Goll
Regional Director
Minerals Management Service
Alaska Outer Continental Shelf Region
949 E. 36th Avenue, Room 603
Anchorage, Alaska 99508-4302

Dear Mr. Goll:

Thank you for requesting information regarding the presence of Federally listed threatened or endangered species or critical habitat that are managed by the National Marine Fisheries Service (NMFS) and may be affected by the proposed oil and gas activities that are being analyzed in the Integrated Activity Plan and Environmental Impact Statement for the National Petroleum Reserve on the North Slope of Alaska. This letter identifies those species which occur in California and are managed by the Southwest Region of NMFS. You should contact the Portland, Oregon office of our Northwest Regional office (503-231-2005) to obtain information on listed or proposed species occuring in Idaho, Washington, and Oregon.

Listed species occurring in California, in addition to those identified in your letter, include the following: (1) endangered Sacramento River winter-run chiook salmon (55 FR 46515 and 59 FR 440), (2) threatened Central California Coast coho salmon (61 FR 56138), and (3) threatened Southern Oregon/Northern California Coast coho salmon (62 FR 34588). Critical habitat has been designated for the Sacramento River winter-run chinook salmon (58 FR 33212). Critical habitat has not been proposed or designated for either of the two species of listed coho salmon. Proposed species occurring in California include several populations of steelhead (61 FR 41541): (1) Southern California Coastal steelhead, (2) South-Central California Coastal steelhead, (3) Central California Coastal steelhead, (4) Northern California

Printed on Recycled Paper

Coastal steelhead, (5) Klamath Mountains Province steelhead, and (6) Central Valley steelhead. Critical habitat has not been proposed for any of these species of steelhead as yet. NMFS expects to publish a final listing decision regarding the proposal to list these steelhead populations by August 8, 1997.

If you have any questions regarding listed or proposed species managed by the Southwest Region of NMFS, please contact Mr. Craig Wingert at (310) 980-4021.

Sincerely,

for James H Lecky

William T. Hogarth, Ph.D.
Acting Regional Administrator

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. Tudor Rd.
Anchorage, Alaska 99503-6199

JUL 2 1997

IN REPLY REFER TO:
AES/ESO

Memorandum

To: State Director
Bureau of Land Management

From: Acting Regional Director Robyn Thorson
Region 7

Subject: Request for List of Threatened and Endangered Species Potentially Affected by Proposed Oil and Gas Lease Sale in the National Petroleum Reserve-Alaska (NPR-A)

This responds to your May 6, 1997, request for a list of proposed and listed threatened and endangered species, which may be affected by activities, including oil and gas leasing, in the northeast portion of NPR-A (Planning Area). This information is for your use in preparation of the Integrated Activity Plan/Environmental Impact Statement, now in progress, which will address the full range of the Bureau of Land Management's responsibilities for the Planning Area.

As indicated in your memorandum, there are no designated or proposed critical habitats for any listed or proposed species potentially affected by activities in the Planning Area. The following listed species occur in the Planning Area.

Common Name	Scientific Name	Status
Spectacled eider	*Somateria fischeri*	threatened
Steller's eider	*Polysticta stelleri*	threatened (Alaska breeding pop.)

Please note that threatened status for the Steller's eider will become effective on July 11, 1997.

Analysis of the potential effects of oil and gas leasing on species that occur along the expected oil transport corridor is required. The Short-tailed albatross (*Diomedea albatrus*) is listed as a "foreign" endangered species under the Endangered Species Act of 1973, as amended; it is therefore considered listed anywhere outside the 3-mile territorial limit of the United States. Whereas waters beyond 3 miles are regulated for United States fisheries and off-shore mining to the 200-mile limit, the requirements for section 7 consultation apply to activities that occur between 3 and 200 miles from U.S. shores relative to "domestic" or "foreign" species. Therefore, section 7 consultation is required for tankering activities, which may adversely affect short-tailed albatrosses in the event of an oil spill or other marine accident.

We are also providing a provisional list of endangered, threatened, and candidate species occurring in coastal areas of California, Oregon, and Washington (attached). This list was provided to us by the Service's Regional Director, Region 1, on June 17, 1997, for use in the evaluation of Outer Continental Shelf Lease 170. Given the recent date, it is unlikely that there will be any changes to this list, but we are in the process of obtaining Region 1's concurrence for use of this list as the basis for your biological assessment. Your memorandum stated your intention to evaluate potential effects of oil transport by reference to biological evaluations prepared for Outer Continental Shelf Oil and Gas Lease Sales 149, 158, and the Final Environmental Impact Statement for Sale 144. This decision was made on the basis that the oil transport scenario for NPR-A would be similar to those analyzed for the previous lease sales. We have no objection to this approach, in general, except to note that additional analyses will be necessary for species proposed or listed since those documents were prepared.

We understand that your staff, and that of Minerals Management Service, are operating under a demanding schedule, and we will attempt to expedite transfer of any additional information. Please contact Philip Martin at (907) 456-0325 if you have any questions concerning this response. We look forward to continuing cooperation through all phases of the consultation process.

Attachment

ATTACHMENT

ENDANGERED, THREATENED, AND CANDIDATE SPECIES AND SPECIES OF CONCERN FOR COASTAL AREAS OF CALIFORNIA, OREGON, AND WASHINGTON

LISTED

MAMMALS

Pacific pocket mouse	*Perognathus longimembris pacificus* (E)
Point Arena mountain beaver	*Aplodontia rufa nigra* (E)
Salt marsh harvest mouse	*Reithrodontomys raviventris* (E)
Southern sea otter	*Enhydra lutris nereis* (T)

BIRDS

Aleutian Canada goose	*Branta canadensis leucopareia* (T)
American peregrine falcon	*Falco peregrinus anatum* (E)
Bald eagle (Washington, Oregon)	*Haliaeetus leucocephalus* (T)
Bald eagle (California)	*Haliaeetus leucocephalus* (E)
Brown pelican	*Pelecanus occidentalis* (E)
California clapper rail	*Rallus longirostris obsoletus* (E)
California least tern	*Sterna antillarum browni* (E)
Coastal California gnatcatcher	*Polioptila californica californica* (T)
Least Bell's vireo	*Vireo bellii pusillus* (E, CH)
Light-footed clapper rail	*Rallus longirostris levipes* (E)
Marbled murrelet	*Brachyramphus marmoratus* (T, PCH)
Northern spotted owl	*Strix occidentalis caurina* (T, CH)
Southwestern willow flycatcher	*Empidonax traillii extimus* (E, PCH)
Western snowy plover	*Charadrius alexandrinus nivosus* (T, PCH)

AMPHIBIANS AND REPTILES

Arroyo toad	*Bufo microscaphus californicus* (E)
California red-legged frog	*Rana aurora draytonii* (T)
Green sea turtle	*Chelonia mydas* (E)

Leatherback sea turtle	*Dermochelys coriacea* (E, CH)
Loggerhead sea turtle	*Caretta caretta* (T)
Olive (=Pacific) Ridley sea turtle	Lepidochelys olivacea (E)
San Francisco garter snake	*Thamnophis sirtalis tetrataenia* (E)

FISHES

Delta smelt	*Hypomesus transpacificus* (T) (CH)
Tidewater goby	*Eucyclogobius newberryi* (E)

PLANTS

Antioch Dunes evening-primrose	*Oenothera deltoides ssp. howellii* (E)
Baker's stickyseed	*Blennosperma bakeri* (E)
Beach layia	*Layia carnosa* (E)
big-leaved crownbeard	*Verbesina dissita* (T)
California sea-blite	*Suaeda californica* (E)
Coastal dune's milk vetch	*Astragalus tener var. titi* (E)
Contra Costa wallflower	*Erysimum capitatum ssp. angustatum* (E)
Del Mar manzanita	*Arctostaphylos glandulosa ssp.crassifolia* (E)
Encinitas coyote bush	*Baccharis vanessae* (E)
Fountain thistle	*Cirsium fontinale var. fontinale* (E)
Gambel's watercress	*Rorippa gambellii* (E)
Howell's spineflower	*Chorizanthe howellii* (E)
Marin dwarf-flax	*Hesperolinon congestum* (T)
Marsh sandwort	*Arenaria paludicola* (E)
Menzies' wallflower	*Erysimum menziesii* (E)
Monterey gilia	*Gilia tenuiflora ssp. arenaria* (E)
Orcutt's spineflower	*Chorizanthe orcuttiana* (E)
Pt. Reyes clover lupine	*Lupinus tidestromii var. layneae* (E)
Presidio clarkia	*Clarkia franciscana* (E)
Presidio manzanita	*Arctostaphylos hookeri ssp. ravenii* (E)
Robust spineflower	*Chorizanthe robusta* (E)
Salt marsh bird's- beak	*Cordylanthus maritimus ssp. maritimus* (E)

San Diego button celery	*Eryngium aristulatum var. parishii* (E)
San Mateo thornmint	*Acanthomintha duttonii* (E)
San Mateo wooly sunflower	*Eriophyllum latilobum* (E)
Sonoma spineflower	*Chorizanthe valida* (E)
Tiberon jewelflower	*Streptanthus niger* (E)
Tiberon mariposa lily	*Calochortus tiburonensis* (T)
Tiberon paintbrush	*Castilleja affinis ssp. neglecta* (E)
Tidestrom's clover lupine	*Lupinus tidestromii var. tidestromii* (E)
Water howellia	*Howellia aquatilus* (T)
Western lily	*Lillium occidentale* (E)
White-rayed pentachaeta	*Pentachaeta bellidiflora* (E)
Yadon's wallflower	*Erysimum menziesii ssp. yadonii* (E)

INVERTEBRATES

California freshwater shrimp	*Syncaris pacifica* (E)
Lange's metalmark butterfly	*Apodemia mormo langei* (E)
Lotis blue butterfly	*Lycaeides argyrognomon lotis* (E)
Mission blue butterfly	*Icaricia icarioides missionensis* (E)
Myrtle's silverspot butterfly	*Speyeria zerene hippolyta* (E)
Oregon silverspot butterfly	*Speyeria zerene hippolyta* (T,CH)
Palos Verdes blue butterfly	*Glaucopsyche lygdamus palosverdesensis* (E)
Quino checkerspot butterfly	*Euphydryas editha quino* (E)
San Bruno elfin butterfly	*Incisalia mossii bayensis* (E)
San Diego fairy shrimp	*Branchinecta sandiegoensis* (E)
Smith's blue butterfly	*Euphilotes enoptes smithi* (E)
Riverside fairy shrimp	*Streptocephalus woottoni* (E)

PROPOSED AND CANDIDATE (Formerly Category 1 Candidate Species)

FISH	
Sacramento splittail	*Pogonichthys macrolepidotus* (PT)
Bull trout	*Salvelinus confluentus* (C)
AMPHIBIANS	
California tiger salamander	*Ambystoma californiense* (C)
REPTILES	
Alameda whipsnake	*Masticophis lateralis euryxanthus* (PE)
INVERTEBRATES	
Behren's silverspot butterfly	*Speyeria zerene behrensii* (PE)
Callippe silverspot butterfly	*Speyeria callippe callippe* (PE)
PLANTS	
Baker's larkspur	*Delphinium bakeri* (C)
Contra Costa goldfields	*Lasthenia conjugens* (PT)
Hickman's cinquefoil	*Potentilla hickmanii* (PE)
La graciosa thistle	*Cirsium loncholepis* (C)
Laguna Beach liveforever	*Dudleya stolonifera* (PE)
Pallid manzanita	*Arctostaphylos pallida* (PT)
Santa Cruz tarweed	*Holocarpha macradenia* (C)
San Bruno Mountain manzanita	*Arctostaphylos imbricata* (PT)
San Francisco lessingia	*Lessingia germanorum* (PE)
Showy Indian clover	*Trifolium amoenum* (PE)
Soft-leaved indian paintbrush	*Castilleja mollis* (PE)
Soft bird's-beak	*Cordylanthus mollis ssp. mollis* (PE)
Sonoma alopecurus	*Alopecurus aequalis var. somomensis* (PE)
Spreading navarettia	Navarretia fossalis (PT)
Thread-leaved brodiaea	*Brodiaea filifolia* (PT)
Yellow larkspur	*Delphinium luteum*

T=threatened; E=endangered, PE=proposed endangered; PT=proposed threatened;
PCH=proposed critical habitat; CH=designated critical habitat

APPENDIX D

Section 810 of ANILCA, Findings and Evaluations

INTRODUCTION: Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA), Public Law (P.L.) 96-487, requires that:

(a) In determining whether to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands under any provision of law authorizing such actions, the head of the federal agency having primary jurisdiction over such lands or his designee shall evaluate the effect of such use, occupancy, or disposition on subsistence uses and needs, the availability of other lands for the purposes sought to be achieved, and other alternatives which would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes No such withdrawal, reservation, lease, permit, or other use, occupancy or disposition of such lands which would significantly restrict subsistence uses shall be effected until the head of such federal agency:

(1) give notice to the appropriate state agency and the appropriate local committees and regional councils established pursuant to Section 805;

(2) gives notice of, and holds, a hearing in the vicinity of the area involved; and

(3) determines that (a) such a significant restriction of subsistence uses is necessary and consistent with sound management principles for the utilization of public lands, (b) the proposed activity will involve the minimal amount of public lands necessary to accomplish the purposes of such use, occupancy, or other disposition, and (c) reasonable steps will be taken to minimize adverse effects upon subsistence uses and resources resulting from such actions.

(b) If the Secretary is required to prepare an environmental impact statement pursuant to Section 102(2)(C) of the National Environmental Policy Act, he shall provide the notice and hearing and include the finds required by subsection (a) as part of such environmental impact statement.

(c) Nothing herein shall be construed to prohibit or impair the ability of the State or any Native Corporation to make land selections and receive land conveyances pursuant to the Statehood Act or the Alaska Native Claims Settlement Act.

(d) After compliance with the procedural requirements of this section and other applicable law, the head of the appropriate federal agency may manage or dispose of public lands under his primary jurisdiction for any of those uses or purposes authorized by this Act or other law.

EVALUATION FACTORS: In general, any action that disturbs the land; its vegetative cover; the quality or quantity of water resources, wildlife, or fish populations; other harvestable resources; or human or animal access routes may have an impact on subsistence uses and needs. To determine if a significant restriction of subsistence uses and needs is likely to result from any of the alternatives discussed in this IAP/EIS, including their cumulative effects, the following three factors in particular were considered:

1) the likelihood of reducing the population or amount of harvestable resources;

2) the likelihood of reducing the availability of resources used for subsistence purposes by alteration of their normal distribution patterns; and

3) the likelihood of limitation of access to subsistence resources

For all three factors, the amounts and locations of reduction or limitation are keys to whether a significant restriction on subsistence uses and needs is occurring. Information presented in the Environmental Consequences section in this document has analyzed and quantified, where possible, such reductions and limitations, if any, and will be referenced below in the various evaluations.

A proposed action will be considered to significantly restrict subsistence uses if, after any stipulations or modification warranted by consideration of alternatives or conditions, it can be expected to result in a substantial reduction in the opportunity to continue subsistence uses of renewable resources. Restrictions on subsistence use would be significant, if there were large reductions in the abundance of harvestable resources, major redistributions of those resources, or substantial interference with harvester access to active subsistence sites.

Conversely, restrictions of subsistence use will not be considered significant if:

- There would be no (or a slight) reduction in the abundance of harvestable resources and no (or occasional) redistribution of these resources.
- There would be no effect (or slight inconvenience) on the ability of harvesters to reach and use active subsistence harvesting sites, and
- There would be no substantial increase in competition for harvestable resources.

ANILCA 810(a) EVALUATIONS AND FINDINGS FOR THE FIVE ALTERNATIVES:
Note: As stated above, there are detailed discussions elsewhere, including in the Environmental Consequences section of this document, not only on the topic of subsistence usage of the area but also on the related issues of potential impacts of oil and gas development on wildlife, habit, and access. All this information is very relevant to the evaluations that follow and is incorporated by reference. Rather than repeat this information, the evaluations will highlight briefly some of the most relevant considerations that support the evaluations and findings made for each alternative.

Compliance with Section 810(a) of ANILCA, Evaluation and Finding for Alternative A:

Section 810(a) Evaluation for Alternative A:

a. The Effect of Such Use, Occupancy, or Disposition on Subsistence Uses and Needs: Under

571

this alternative, there would be no oil and gas leasing. Present management policies and actions for the area that are not now causing a significant restriction on subsistence uses and needs would continue. There also is no indication that the cumulative effects of present management policies and actions in the future would result in a significant restriction to subsistence uses and needs.

b. The availability of other lands for the purposes sought to be achieved:

With the continuation of present management policies and actions, including no oil and gas leasing, there are no new "purposes sought to be achieved," thus the "availability of other lands" is a moot issue.

c. Other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes:

Similar to above, this consideration is a moot issue because ongoing subsistence activities would not be subject to any new actions that are different than the actions presently occurring on this land.

Section 810(a) Finding for Alternative A. Alternative A would not significantly restrict subsistence uses. The direct reasons for this finding are given in the preceding evaluation, with further information supporting this finding in preceding sections in the environmental consequences section of this document.

Compliance with Section 810(a) of ANILCA: Evaluation and Finding for Alternative B:

Section 810(a) Evaluation for Alternative B:

a. The effect of such use, occupancy, or disposition on subsistence uses and needs:

Under this alternative, about half of the study area would be available to oil and gas leasing, though some prime wildlife areas, including the Teshepuk Lake Watershed and Caribou Habitat area would remain unavailable to oil and gas leasing. Pipelines and roads could be authorized for long-term oil and gas activities in some, but not all, areas available for oil and gas leasing. Refer to the subsistence part of the Environmental Consequences section for a discussion of the overall effects associated with Alternative B on subsistence-harvest patterns and associated resources. The overall effects from oil and gas activities in the Northeast NPR-A Planning Area as a result of impacts from disturbance and possible oil spills are expected to periodically (occasionally) impact subsistence resources. However, no resource would become unavailable, undesirable for use, or experience overall population reductions.

b. The availability of other lands for the purposes sought to be achieved: (the same for Alternatives B through E)

This alternative is one of five, which taken together examine the availability of all the lands included in study area addressed in this IAP/EIS. This particular alternative looks at some of the lands for the "purposes sought to be achieved" related to oil and gas development and other management alternatives beyond those currently practiced. Thus, together, the five alternatives are considering all relevant lands so that there are no "other lands" that could be considered.

c. Other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes: (the same for Alternatives B through E)

Similar to the discussion directly above, the various alternatives constitute the "other alternatives" required for consideration by ANILCA Section 810.

Section 810(a) Finding for Alternative B: Some periodic impacts to subsistence resources are possible under Alternative B as explained above. This restriction, however, would be occasional and localized, and no resources would become unavailable, undesirable for use, or experience overall population reductions. Alternative B would not significantly restrict subsistence uses.

Compliance with Section 810(a) of ANILCA: Evaluation and Finding for Alternative C:

Section 810(a) Evaluation for Alternative C:

a. The effect of such use, occupancy, or disposition or subsistence uses and needs:

Under this alternative, approximately 74 percent of the study area would be available to oil and gas development, including additional acreage in the Teshekpuk Lake Watershed. Stipulations, including setbacks for oil- and gas-related developments around fish-bearing lakes and streams would protect water, fish habitat, and wetlands. Refer to the subsistence part of the Environmental Consequences section for a discussion of the overall effects associated with Alternative C on subsistence-harvest patterns and associated resources. The effects on subsistence from oil and gas activities in the Northeast NPR-A Planning Area as a result of impacts from disturbance and possible oil spills are expected to increase somewhat over Alternative B. Periodic (occasional) impacts to subsistence resources are expected, but no resources would become unavailable, undesirable for use, or experience overall population reductions. Consequently, this alternative essentially would have the same level of effect on subsistence uses as Alternative B.

b. The availability of other lands for the purposes sought to be achieved:

See discussion under Alternative B above.

c. Other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes:

See discussion under Alternative B above.

Section 810(a) Finding for Alternative C: Similar to Alternative B, some periodic impacts to subsistence resources are possible under Alternative C as explained above. This restriction, however, would be occasional and localized, though possibly somewhat greater than under Alternative B. However, no resources would become unavailable, undesirable for use, or experience overall population reductions. Alternative C would not significantly restrict subsistence uses.

Compliance with Section 810(a) of ANILCA: Evaluation and Finding for Alternative D:

Section 810(a) Evaluation for Alternative D:

a. The effect of such use, occupancy, or disposition on subsistence uses and needs:

Under this alternative, 89 percent of the study area would be available to oil and gas development, including caribou habit areas within the Teshekpuk Lake Watershed and nesting concentrations for the spectacled eider. The goose-molting habitat would remain unavailable to oil and gas leasing. As in other alternatives, stipulations for setbacks for oil- and gas-related developments around fish-bearing lakes and streams would protect water, fish habitat, and wetlands. Refer to the subsistence part of the Environmental Consequences section for a discussion of the overall effects associated with Alternative D on subsistence-harvest patterns and associated resources. The effects on subsistence from oil and gas activities in the Northeast NPR-A Planning Area as a result of impacts from disturbance and possible oil spills are expected to increase over Alterative B. Subsistence resources would be chronically impacted but no resource would become unavailable, undesirable for use, or experience overall population reductions, resulting in no significant impacts to subsistence-harvest patterns.

b. The availability of other lands for the purposes sought to be achieved:

See discussion under Alternative B above.

c. Other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes:

See discussion under Alternative B above.

Section 810(a) Finding for Alternative D: Restrictions to subsistence resources are expected to increase somewhat over Alternatives B and C, because some chronic impacts to resources are possible under Alternative D as explained above. The impacts to subsistence resources would be chronic but localized and greater than under Alternatives B or C, though resources still would not become unavailable, undesirable for use, or experience overall population reductions. Alternative D would significantly restrict subsistence uses.

Compliance with Section 810(a) of ANILCA: Evaluation and Finding for Alternative E:

Section 810(a) Evaluation for Alternative E:

a. The effect of such use, occupancy, or disposition on subsistence uses and needs:

Under this alternative, virtually all of the study area would be available to oil and gas development. As in other alternatives, stipulations for setbacks for oil- and gas-related developments around fish-bearing lakes and streams would protect water, fish habitat, and wetlands. Refer to the subsistence part of the environmental consequences section for a discussion of the overall effects associated with Alternative E on subsistence harvest patterns and associated resources. The effects on subsistence from oil and gas activities in the Northeast NPR-A Planning Area as a result of impacts from disturbance and possible oil spills are expected to increase over Alterative B. Subsistence resources would be chronically impacted but still no resource would become unavailable, undesirable for use, or experience overall population reductions, resulting in no significant impacts to subsistence-harvest patterns. However, while effects are not expected to have significant impacts on subsistence-harvest patterns in Barrow and Atqasuk, oil-development activity under Alternative E could make Nuiqsut's pursuit of caribou more difficult for at least an entire harvest season.

b. The availability of other lands for the purposes sought to be achieved:

See discussion under Alternative B above.

c. Other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes:

See discussion under Alternative B above.

Section 810(a) Finding for Alternative E: Alternative E would cause more restriction to subsistence uses than Alternatives B, C, or D, because some chronic impacts to subsistence resources are possible under Alternative E (especially to Nuiqsut) as explained above. The impacts to subsistence resources would be chronic but localized and greater than under Alternatives B, C, or D, though resources would still not become unavailable, undesirable for use, or experience overall population reductions. As stated above, this is particularly true for Nuiqsut where the pursuit of caribou by residents could become more difficult for at least an entire harvest season. Alternative E would significantly restrict subsistence uses.

Summary of ANILCA Section 810 (a) Findings: The findings for the five alternatives were the same for Alternatives A through C: each would not significantly restrict subsistence uses, though the severity and location of this restriction varied. The findings for Alternatives D and E were that they would significantly restrict subsistence uses. (See preceding Section 810 (a) evaluations for each alternative.)

575

APPENDIX E

Proceedings of the Teshekpuk Lake Area Caribou/Waterfowl Impacts Analysis Workshop

516

BLANK PAGE

PROCEEDINGS OF THE
TESHEKPUK LAKE AREA
CARIBOU/WATERFOWL IMPACTS ANALYSIS WORKSHOP

MAY 21-22, 1997

FAIRBANKS, ALASKA

Edited by

DAVID A. YOKEL

Bureau of Land Management

Northern District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

NORTHERN DISTRICT OFFICE

1150 University Avenue

Fairbanks, Alaska 99709-3899

Appendix E-1

Table of Contents

Introduction

- Purpose
- **E-4**
- Scope
- **E-4**
- Format
- **E-4**
- Agenda
- **E-4**
- Attendees
- **E-5**

Preliminary Information
- **E-6**
- Overview of Caribou Use
- **E-6**
- Overview of Waterfowl Use
- **E-7**
- Oilfield Design Options and Wildlife Mitigation
- **E-7**

Proceedings of the Waterfowl Panel
- **E-10**
- Review of Current Knowledge
- **E-10**
- Development of Stipulations
- **E-11**
- Draft Waterfowl Stipulations
- **E-14**

Proceedings of the Caribou Panel
- **E-15**
- Review of Current Knowledge
- **E-15**
- Development of Stipulations
- **E-19**
- Draft Caribou Stipulations
- **E-21**

Group Review and Synthesis of Stipulations
- **E-22**
- Review of Stipulations
- **E-22**
- Residual Impacts
- **E-24**
- Buffer Widths for Goose Molting Lakes
- **E-24**
- Development of Combined Set of Stipulations
- **E-25**

Final Workshop Stipulations
E-25
Suggested References
E-26
Appendix A, Teshekpuk Lake Area Development Questions
E-36
Appendix B, Molting Geese in the Teshekpuk Lake Area
and Migratory Birds of the Arctic Coastal Plain
E-38

Figures

Figure 1. Geographic Scope of Workshop
E-30
Figure 2. Goose Molting Area
E-31
Figure 3. Preferred Goose Feeding Habitat
E-32
Figure 4. Caribou Calving and Summer Use Area
E-33
Figure 5. Crucial Movement Corridors for Caribou
E-34
Figure 6. Buffers Around Goose Molting Lakes
E-35

Introduction

Purpose

The Bureau of Land Management held the Teshekpuk Lake Area Impacts Analysis Workshop on May 21 and 22, 1997, to provide BLM with guidance for developing a package of stipulations for an environmental impact statement alternative that would allow oil and gas leasing in the Teshekpuk Lake area (Figure 1). BLM wanted the invited panelists to identify the conditions under which development could be allowed "in a manner which will assure the maximum protection of such surface values to the extent consistent with the [Naval Petroleum Reserves Production Act of 1976]." There were two constraints on discussion at this meeting: the results must allow economically viable oil development, but with protection for caribou and waterfowl.

Scope

- Review options for "reduced-impact oil fields."
- Review existing information pertaining to the response of waterfowl and caribou to oil and gas development.
- Formulate a realistic development alternative that minimizes impacts to waterfowl and caribou.
- Evaluate the likely residual impacts to waterfowl and caribou, under the alternative formulated above.

Format

The workshop had facilitators to help meet the goals in the short time allowed. The panels consisted of agency representatives with knowledge in waterfowl or caribou biology, wildlife interactions with North Slope oil and gas activities, or oil field development. Panel members reviewed relevant studies prior to the workshop. Representatives from the oil and gas industry, as well as invited nonagency biologists, provided background information in an initial information-gathering phase.

The second phase of the workshop was limited to agency personnel, indicated as panelists in the list on page 6. In addition to the invited workshop participants, a letter was sent to various organizations with relevant interests. The letter requested information addressing the questions in Appendix A, or information related to wildlife interactions with North Slope oil developments that would be pertinent to the development of mitigation measures. No responses were received. The draft proceedings of the workshop were distributed to panelists for review. This final edition of the proceedings will be included in BLM's administrative record.

Agenda

May 21
I. *Overview of Caribou and Waterfowl Use of Teshekpuk Lake Area*

Two brief presentations
II. *Explore Options for Reduced-impact Oil Fields*
Figure 1.

Presentation by industry representatives (ARCO), addressing topics such as minimally-staffed oil fields, remote control of production facilities, buried vs. above-ground pipelines, roadless oil fields, minimal air traffic, etc. Discuss advantages and disadvantages of various development options.

III. *Apply the Prudhoe Bay Experience to the Teshekpuk Lake Area*
Waterfowl and caribou panels meet separately. Invited biologists assist in interpreting recent work on disturbance of birds and caribou, and studies emanating from the existing North Slope oil fields. The goal is to define the extent to which studies in the existing oil fields can be used as a model for Teshekpuk Lake.

May 22 (panelists only):
IV. *Formulate Stipulations for Teshekpuk Lake Area*
Waterfowl and caribou panels meet separately. Based on the development options presented earlier, panelists formulate a set of conditions on oil field construction and operations that would maximize protection of waterfowl and caribou, without precluding oil and gas development.
V. *Synthesis*
Waterfowl and caribou panels meet together to identify conflicts between their respective mitigation plans. Panelists attempt to formulate a unified approach to mitigation for both waterfowl and caribou. Residual impacts and environmental risks of the mitigation plan(s) are assessed.

(Note: The workgroup was not completely successful in accomplishing all of this aggressive agenda during the two days allowed. Follow-up meetings involving a subset of attendees were needed on May 28 and June 2 to flesh out one of the waterfowl stipulations and to merge the two sets of stipulations.)

Attendees

Dave Yokel, BLM (workshop organizer, caribou panelist)
Herb Brownell, BLM (facilitator)
Susan Will, BLM (facilitator)
Ryan Lance, ARCO (invited speaker)
Mike Joyce, ARCO (invited speaker)
Sharon Wilson, BLM (notetaker)
Sue Mitchell, Inkworks (notetaker)
Philip Martin, USFWS (waterfowl panelist)
Joel Hubbard, MMS (waterfowl panelist)
Anne Morkill, BLM (waterfowl panelist)
Tom Rothe, ADF&G (waterfowl panelist)
Geoff Carroll, ADF&G (caribou panelist)
Dick Shideler, ADF&G (caribou panelist)
Brian Lawhead, ABR (invited biologist, caribou)
Brad Griffith, USGS-BRD (caribou panelist)
Alan Brackney, USFWS (waterfowl panelist)
Karen Bollinger, USGS-BRD (speaker, waterfowl)
Gene Terland, BLM (observer)

Jim Ducker, BLM (observer)
Curt Wilson, BLM (observer)
Mike Kunz, BLM (observer)
Johanna Munson, State of AK (observer)
Mark Myers, ADNR (petroleum development specialist, waterfowl panelist)
Joseph Dygas, BLM (petroleum development specialist, caribou panelist)
Jim Craig, MMS (petroleum development specialist, waterfowl panelist)
Dick Roberts, MMS (observer)
Don Hansen, MMS (caribou panelist)
Marie Crosley, ADNR (observer)
Dick Mylius, ADNR (observer)
Pam Rogers, ADNR (observer)
Bill Van Dyke, ADNR (petroleum development specialist, caribou panelist)
Declan Troy, TERA (invited biologist, waterfowl)
Steve Murphy, ABR (invited biologist, waterfowl)
Craig George, NSB (caribou panelist)
Ken Whitten, ADF&G (caribou panelist)
Jack Winters, ADF&G (waterfowl panelist)
Phyllis Casey, MMS (observer)
Frank Wendling, MMS (waterfowl panelist)
Roger Siglin, Northern Alaska Environmental Center (observer)
Robert Suydam, NSB (waterfowl panelist)
Eric Taylor, UAF (invited biologist, waterfowl)

Preliminary Information

Overview of Caribou Use

Ken Whitten of ADFG presented information on caribou in the Teshekpuk Lake and Prudhoe Bay areas. A herd is defined as having a consistent calving area, and the Teshekpuk Lake Herd (TLH) is more consistent than others. When first recognized as a distinct herd, it was estimated at 4,000 to 6,000 animals and was 25,000 at last count. There is a fairly high level of harvest.

As regards potential development in the area, the only herd for which we have data is the Central Arctic Herd (CAH). Its population was similar to the TLH when oil was discovered. It increased rapidly to a peak of 23,000 in 1992, but in contrast to the TLH, it declined to 18,000 by 1995. The first signs of impacts from earliest construction were that few cows with young calves were spending any time next to roads. The CAH calving grounds, between the Colville and Canning Rivers, are spread out over a greater area than the calving grounds of the TLH.

There are two separate calving concentration areas: one at Kuparuk and Milne Point, and one at Canning River. The road to Milne Point went through the western calving area. Cows avoided the road by one to three miles. As development increased and there were more facilities, there was less use of the area for calving and calving cows moved south and west. Midsummer movements through the area persisted, but caribou have not passed freely. Collared caribou from the western area were in worse physical condition in fall than those from where there was no development. All decline in population has taken place in the portion of the CAH from the developed, western area. In summary, there is no proof of oil field impacts on herd productivity, but there is at least reason for concern. Many of the Prudhoe Bay/Kuparuk developments were designed 15-25 years ago; future development may not be the same. But there is a correlation between the extent of surface structures and caribou activities.

Overview of Waterfowl Use

Karen Bollinger of USGS-BRD presented data on molting geese in the Teshekpuk Lake Special Area (Appendix B). The survey area encompassed 199 lakes and Smith Bay, with data for 15 years from 1982 to 1996. Total number of geese varied from 19,000 to 68,000 with an average of 38,000. Molting geese are few in number outside the survey area. The four species present are Canada goose, Pacific black brant, white-fronted goose and snow goose. The total number of all geese using the area over 15 years indicates an increasing trend, primarily due to an increase in white-fronted geese. Of the total Pacific black brant population worldwide, up to 22 percent molt in this area. Snow geese are few, usually less than 500. On average, brant comprise about 46 percent, Canada geese 34 percent and white-fronted geese 19 percent of the molting geese in the area. There are a few breeders, but most are either failed breeders or nonbreeders.

All species use the area northeast of Teshekpuk Lake, with Canada geese and brant sharing several of their highest-use lakes. Brant tend to occur in larger flocks on fewer lakes. Variation is high among years, and the survey is only conducted on one day each July during the peak of molt for all species. On average, eight lakes support 50 percent of the brant; one lake is used by over 3,000. The molt period lasts for about a month and then goose distribution changes. Geese tend to move to coastal areas before leaving the Teshekpuk Lake area entirely.

Brant are an international concern and this area is of high international importance. Birds molting in the Teshekpuk Lake area come from Russia, Alaska and Canada, and winter in Mexico. This area is unique on the North Slope, having large lakes with adjacent meadows, escape cover, and good forage availability

Oilfield Design Options and Wildlife Mitigation

Mike Joyce, an ARCO biologist, and Ryan Lance, an ARCO engineer, provided their perspective of what practices might be used to protect wildlife while still allowing development

The greatest problem for caribou is stress from traffic, which has caused all the changes in CAH distribution. This can be mitigated when designing the layout of an oil field and by monitoring caribou movement and stopping traffic when caribou are near the road and about to cross. An oil field in NPR-A would not be the size of Kuparuk and they expect this should work, although there are no data to test this mitigation.

During the three-week calving season, there is avoidance of roads with traffic. Some calving still occurs in the Kuparuk oil field, but the bulk of calving has shifted to the south and west. Following calving, caribou are present on the coastal plain during the insect season. Before there were gravel pads, caribou went to river bars to avoid insects; now they use the gravel pads. Caribou are not bothered by the presence of a drill rig, the gravel pads, or the pipe. If pipes are built a minimum of five feet above ground and separated from roads, they aren't a problem for caribou during insect season.

The current assumption is that sales-oil pipelines from NPR-A would not have associated roads, but this would have to be decided on a case-by-case basis. Prudhoe and Kuparuk are giant oil fields; there's less than a one percent chance of finding one of that size in northeastern NPR-A. Eventually there could be a threshold number or size of oil fields when roads to the oilfields are less disturbance than the alternatives. In the short term, it is believed roads won't be needed. Rather than using surface vehicles, pipeline spill monitoring can be done daily using forward-looking radar (FLR) from airplanes and detection systems on the line. The FLR can operate from any altitude, if there are no clouds. One trade-off of having no road is that a large-aircraft runway is required in case of a well blow-out. A jet operation would not be necessary, but for oil spill response the capability to land a Herc is required.

Another trade-off is that more space is needed to store equipment that can be brought in only during the winter. Finally, oil field crews change at least once a week. Between that and air transport of supplies, maybe one flight a day would be needed.

For birds, the problem is noise and commotion, which can also be mitigated. ARCO monitors tundra swan nests, which are a prime indicator for long-term information because swans are most sensitive to noise and commotion. Swan numbers have risen rather dramatically in the last three to five years and nesting densities are comparable to historical levels. ARCO has classified habitat into 21 types, and with Geographical Information System software they can better estimate where birds may concentrate during seasonal events and therefore where facilities should be sited to minimize noise and commotion.

ARCO has also been conducting site rehabilitation experiments. NPR-A doesn't have the quality of gravel as found in Prudhoe/Kuparuk; the grain size is smaller. Even thick gravel fill can be rehabilitated if moisture and nutrient cycles are properly addressed. The effects of seeding and fertilizing last only two to three years. With the addition of topsoil and grasses a long-term, sustained vegetative cover can be produced. However, it's a monoculture and slows down the invasion of natural pioneer species. There is a benefit in not developing a monoculture; ARCO has gone to seeding with partial application rates and transplant plugs or seed from natural plants. This provides a more rapid progression to the diverse vegetative community desired.

Collection and disposal of food waste in a way that attracts predators to camp locations can also stress bird nesting activity. Trash is currently placed in dumpsters, transported to landfills, or incinerated. This provides access to food by predators. There are pilot studies on composting at the mess hall in self-enclosed vessels. Composting may be the norm at future camps that will be smaller--50 to 100 people as opposed to thousands at Kuparuk.

(The remaining discussion was directed to questions in Appendix A that had not already been addressed.)

In regard to the question of oil field design and what level of on-site processing would be needed, the size of the oil field at Prudhoe requires six dedicated processing facilities. The Alpine oil field, which is more representative of the potential opportunities in NPR-A, has these same functions and everything else on two pads. Pads in NPR-A would average 8-10 acres each. Considering the tradeoffs, it's best to keep processing close to the wells because multiphase lines have a higher probabilty of spill.

It is hard to predict what type of oil field support infrastructure would be required in NPR-A. It can probably be done a lot more efficiently than Deadhorse. As much as it can, ARCO would try to avoid another Deadhorse in NPR-A.

Two to three years before starting up oil field development there would be a lot of activity that usually occurs during winter. One option for access is building a dock into the Beaufort Sea and barging equipment from Prudhoe or Kuparuk, but tradeoffs exist. Is a dock better than a seasonal ice road? Are year-round ice pads possible? If so, how much refrigeration is required? Is there another set of environmental problems?

How different drainages would be crossed depends on their characteristics. ARCO will try to cross the Colville by drilling underneath. They contemplate trenching in other places, but not in the Colville. Each drainage has its own set of considerations.

How feasible is horizontal directional drilling? There is a distinction between horizontal drilling and extended-reach drilling. Each is feasible given the right situation. Alpine would have required three or four drill sites in the past; now extended reach drilling will require only two sites. The current record is a reach-to-depth ratio of 4:1. The shallower the oil, the less the reach.

Is an oil field without roads connecting pads feasible? It's technically feasible but not an appropriate tradeoff due to the increased need for local air traffic. With roads, helicopters would be needed only for spill response.

The tradeoff in elevating pipeline eight feet vs. five feet is more expense. Different equipment is needed for construction after about six feet. The extra three feet makes a significant difference in the equipment needed, and thus in costs, but it doesn't make a big difference to caribou. The terrain goes up and down but the pipeline doesn't since rapid topographical changes in the pipe are undesirable, so over 60 percent of the line is well above five feet above the terrain.

Buried pipelines may be feasible and cost-effective, but burial clearly disrupts the tundra. Also, future needs may change, causing the need to dig up and rebury. But foremost is the concern for thaw and freeze of permafrost. Crude oil is hot, and you have to insulate heavily or place the pipe in thaw-stable rock. Pipe can be buried in the road, but it's very expensive and bad from a spill and leak perspective. Also culvert drainage is a difficulty.

Existing DEW-line sites would be given priority for new facilities if they're properly located. However, there is a technical limit to reaching the oil reservoir with the drill.

In general, ARCO wouldn't allow public access to oilfield facilities, but would allow Native subsistence access.

On the question of whether industry would consider sharing seismic data, from ARCO's perspective that would be a big hurdle. Those data are considered a key competitive aspect of the business.

In terms of levels of operations, Alpine will be radically different from Kuparuk; it will have only minimal staff. The technology is not quite there yet to have unmanned sites. Starting in 1998 at Alpine, there will be a lot of activity for two years in winter, with hundreds of people needed then. There would be no impact on animals living there in summer except for drilling. Normal operating mode would need 20 to 40 people.

The economics of completely stopping operations for two to three months are prohibitive in these small fields. A drill rig is not conducive to shutting down in mid-well, nor would it be economic to plan the drilling schedule to stop drilling for two months. There's more to it than just shutting down for two months and not getting two wells drilled. It's dependent on the need to keep the reservoir in balance. Recovery from the field as a whole could be reduced. The optimum would be continuous drilling activity for four or more years. During critical time periods ARCO can try to reduce the number of people. However, ongoing operations are different. If ARCO can figure out how to run with five people rather than 25, it will.

In summary: 1) Complete shut down for the caribou/geese critical period is not economical. People will be present at all times, with a daily commute if their worksite is on a different pad than the camp. 2) remote operation is not yet technically feasible but has potential for the future. 3) It is not economically feasible to suspend drilling during that period, but minimal staffing and reduced access can be accomplished.

Proceedings of the Waterfowl Group

Review of Current Knowledge

Molting geese are flightless and more sensitive to disturbance than during other periods. The Teshekpuk Lake area has been traditionally used by molting and breeding geese for thousands of years (Figure 2). The primary needs of molting geese there are protection from disturbance, available and adequate food supply within close proximity to escape habitat, low predator density, and escape habitat (open water, ice floes). Factors that cause disturbance of waterfowl are predators (including foxes), aircraft overflights, humans on foot, vehicle traffic, noise and commotion. Factors that may affect the availability of an adequate food supply are changing water levels in lakes, developments which restrict goose access to food, habitat loss, contaminants, previous grazing by geese or caribou, nutrient cycling, weather, and overpopulation from lack of predation. Factors that limit escape habitat are weather (influence on ice), topography, hydrology, habitat loss, lake levels (thaw cycle, drainage, modified hydrology, etc.), disturbance, access/proximity (escape has to be near to feeding areas), channelization or drainage patterns (connection of lakes to each other), size of habitat unit, and proximity of lakes to each other. Predator populations are affected by availability of lemmings and other alternative prey species, garbage, supplemental food, human harvest, artificial nesting habitats, number of geese, and disease. Traditional use of lakes by geese may be influenced by habitat modification, population size, frequency of disturbance, and distribution changes.

There are not enough data to say definitively which of the above factors is a higher priority for molting geese or how some may be related to oil field development. The Prudhoe Bay studies funded by ARCO provided data on 400 to 500 birds, but these may not apply to the thousands of birds at Teshekpuk. A couple of studies have indicated that land traffic per se was not a problem, but people on foot frighten the geese quite a bit. In two brood-rearing areas, one near high traffic and one near low traffic, the high-traffic-area geese reacted less, perhaps suggesting habituation to consistent traffic over time. It may be safe to assume that humans on foot and helicopter traffic are the two most disruptive of anthropogenic factors to molting geese.

Culverts may be a high priority problem, if they cause flooding of an entire goose colony. Indirect effects such as hunter access can be much greater than direct effects, to which birds can habituate. Birds become more wary during nesting. During fall staging for migration, distribution is more related to food than to disturbance.

During work on four species of geese, Steve Murphy ranked disturbance using three criteria: severity of reaction, duration of response, and distance moved. Over five years, he looked at humans on foot, nonpredators, avian predators, ground predators (fox), and aircraft. He investigated the distance at which disturbance seems to drop off. Failed breeders and nonbreeders may respond differently, for example, nonbreeders may spend more energy to get away because they're not tied down by a brood.

Studies by Eric Taylor looked at changes in brant body mass, protein levels, and lipid levels from arrival to departure on the molting grounds. There was a significant protein deficit and decrease in lipids. Brant may select the Teshekpuk area as much for lack of disturbance as for available nutrition. In fact, the nutrition available may not be optimum. Brant molting near Teshekpuk are primarily from the Yukon-Kuskokwim Delta. Almost all lipids are lost during the molt period, down to about two percent. The geese also incur a protein deficit during that time.

Would geese from the Yukon-Kuskokwim Delta react differently than birds born and raised at Prudhoe, where there's already disturbance? Geese react strongly to any disturbance, and there may be a critical time while choosing a place to molt when disturbance will cause geese to move elsewhere.

Some restrictions could be placed on oilfield work during summer to reduce pressure on geese while still allowing development to proceed. If ground access was by ice road only, large materials would not be hauled in during the summer, nor would they be flown in by large planes during the sensitive period (mid-June through August). Modules could be flanged up during summer, but all basic construction would take place in winter. If surveyors on foot cause problems to molting geese, they could survey during early spring or late summer to avoid the molting period.

If drilling would be continuous for a few years, there would have to be some transport of people during summer. ARCO accepts access restrictions for large noisy planes and pre-stages heavy equipment and materials before the sensitive period. Air traffic can't be stopped completely, but the number of times a small, relatively quiet plane goes in during the sensitive period may be restricted to perhaps three to four times a week at Alpine. Also, if there is an airstrip, there would be no need for helicopters other than in emergencies. Fixed-wing aircraft are less of a disturbance than helicopters. Also, the frequency of disturbance is important. Taylor's study suggests that the geese have little energetic margin.

Perhaps a "no development" buffer of one to two kilometers could be established around each of the high-use lakes, unless overlapping buffers would preclude development entirely in some areas. If so, perhaps development in those places could be limited to low-disturbance activities. Drilling from outside buffers could possibly reach out 15,000 feet and effectively tap reservoirs. The presence of a cross-country pipeline with no road shouldn't stress birds, so pipelines needn't be excluded from buffer areas.

Development of Stipulations

A draft set of stipulations was introduced to the panel for discussion. The stipulations were based on the following assumptions.

- Geese habituate fairly well to structures.
- Disturbance due to vehicle traffic is mild beyond 200 feet.
- Chronic disturbance due to aircraft is very detrimental and the altitude required to mitigate it is unreasonable given local weather conditions, so the focus should be on limiting frequency and establishing routes of travel.
- Humans on foot are the most disturbing factor.
- Permanent roads that allow access would have detrimental effects in the long term

Preliminary Ideas Presented for Discussion:

1. Restriction on density of production pads, one per township.
2. No habitat alteration permitted in goose feeding areas.
3. Interfield roads permitted but no road connection to outside road network.
4. Gravel fill for roads would be removed upon completion.
5. All facilities located a minimum of 400 meters from documented-use lakes, as far as possible away, and 2,000 meters from highest-use lakes (use averaged over 15 years).
6. Cross-drainage structures will be sited and maintained so as to prevent impoundment or alteration of hydrology.
7. Material sites not permitted within the molting area.
8. Processing sites shall be preferentially located outside the goose molting area, providing that

the multiphase pipeline does not exceed x miles. Alternatively, processing facilities shall be located to maximize the distance from the critical lakes.

9. Processing facilities shall not be sited closer than 2x to each other.
10. Facility layout shall give maximum consideration to shielding human activity from view of the closest goose molting lake.

Seasonal restrictions on activities, June 15 to
August 30:

11. Helicopter overflights shall be suspended.
12. Routine fixed-wing flights limited to two flights/week.
13. Flight corridors established for designated routes that minimize disturbance to molting geese (generally 3 km lateral from high-use lakes). Use of corridors mandatory, except in emergency.
14. Off-pad activity shall be prohibited except in emergencies.
15. Construction activities suspended.
16. Road traffic minimized. Transportation of personnel between camps/pad facilities limited to coincide with shift changes. Nonessential operations requiring vehicles other than passenger vehicles shall be suspended.
17. Public access to oil field facilities shall be restricted.

The details of #5 need further work in regard to the width of buffers and the number of lakes to which #5 should apply. Goose feeding areas are typically to the east and west of the lakes, not north and south, so buffers could be adjusted accordingly. It may be difficult to justify the buffer width using only the studies done at Prudhoe. The question remains as to whether those studies apply to the Teshekpuk area, which is unique on the North Slope and may need greater restrictions. However, with the high lake density of the area, larger buffers would effectively eliminate oil development, thus violating one condition of the workshop discussion. The details on buffers (where and how wide) were postponed for the time being.

The use of surface water for oil field development and operation could result in excessive draw-down of lakes. This may result in only a few inches change in the water level, but that change could affect preferred goose feeding areas (Figure 3) along lake margins. These are very flat areas barely above current lake level. A small change in water level could alter the vegetation community present. Also, the activity associated with water removal could disturb geese. For both of these reasons the restriction of surface water extraction would be necessary.

Restrictions on waste disposal should also be implemented. Putrescible garbage needs to be handled and disposed of so that it will not be available to predators. Disposal is not the problem, handling is. Although this is covered under state law, current facilities are not succeeding in this arena. Also, feeding of most wildlife is prohibited by state law but is not adequately enforced. In addition to current law, the feeding of gulls and ravens should be prohibited. Finally, proper planning and training for oil field workers are crucial for avoiding increases in the predator populations.

Fuel storage stipulations would also be helpful. The lakes are in basins, so spilled fuel could drain into the lakes from a long distance. Storage of fuels and all hazardous materials should be restricted to gravel pads. However, fuel is also needed before pads are built. Existing regulations will have to be sufficient in this case.

Increased access because of roads could pose a serious threat to molting geese. Currently, public access is extremely limited and it is important that it remains so. However, regulation of human access on public lands is difficult. Title VIII of the Alaska National Interest Lands Conservation Act doesn't allow anything to occur on federal land that limits subsistence access, unless there is a finding of a significant impact on subsistence and there are public hearings. Ice roads would not be part of this problem, since they do not persist long enough in the spring to provide people with access to molting geese. Gravel roads connected to the highway network or local villages would present a problem. The goal should be to do nothing that would provide increased opportunity for access.

A process must be established to manage subsistence access. A greater effort to work with subsistence users and address these issues would help. Such a process needs to involve the North Slope Borough and local residents. Another facet of this effort might be to have a state and federal monitoring body that would implement studies, conduct integrated planning, find permitting solutions, and promote interagency relationships. This issue of subsistence access would not be appropriate as a stipulation on oil companies.

Closer monitoring of molting goose populations before, during and after development would help measure any impacts and the success of mitigation. Flights once a week to survey goose distribution would not negatively impact the geese, but would provide data on the pattern of their movements.

The draft restriction on the density of production pads to one per township may be unreasonable from a development standpoint because it isn't possible to reach a whole township from one pad if the oil field is shallow. Would it be better to have one large site or 10 smaller ones? This would be a moot point if there were appropriate buffers that would restrict development to areas where it doesn't impact geese.

No habitat alteration should be permitted in preferred goose feeding areas (Figure 3), which are moss/sedge meadows adjacent to lakes. This type of activity would also be precluded by buffers. Is it better to build ice roads over tundra and avoid the lakes? Meadow habitat is only two to three inches above the lake; is it more sensitive to ice roads? These meadow habitats can be mapped and then stipulations worded so there is no net loss of high-value foraging habitat. Perhaps all exploration and development activities should be prohibited in preferred brant feeding areas.

Gravel intrafield roads should not connect to road networks outside the goose molting area, and gravel fill should be removed, or roads otherwise made unusable, after the life of the field. It isn't enough to avoid connection to existing roads east of the Colville River, since Nuiqsut is west of the Colville. There is concern about future roads, public access and disturbance of molting geese. The general concept is to limit access and consolidate nodes of activity. Road networks should be reduced in size and consolidated as much as possible. It would be preferable to have no roads between oil fields, but only necessary roads within each developed field. Processing and other facilities could contribute directly to goose disturbance as well as to the complexity of the road network, so they should also be consolidated.

Impoundment or alteration of the hydrologic regime could negatively impact both foraging and escape habitats. Cross-drainage structures must be sited and maintained to prevent negative impacts, and properly abandoned once the gravel pad is no longer needed.

Material sites could have adverse impacts on geese both through habitat alteration and disturbance. They should not be permitted within buffer areas, and their operation may be restricted when molting geese are in the area.

Since humans on foot may represent one of the greatest disturbances to molting geese, facility layout must incorporate features that shield human activity from view of the closest goose molting lakes. Fencing on the appropriate sides of gravel pads may meet this need.

BLANK PAGE

Many activities should be restricted while molting geese are present to reduce the disturbance of geese. A decision on the dates of seasonal restrictions was postponed. Helicopters are one of the greatest disturbances to molting geese. Since it has already been established that helicopters are not essential where fixed-wing access exists, helicopter flights should be prohibited seasonally except in emergency.

Off-pad activity could be highly disturbing and should be kept to a minimum. This requirement would be for lease holders only and couldn't be applied to the general public. Since monitoring the geese and other studies would be necessary throughout development and operations, and lessees might be involved, consultation with agencies could be used to determine when these activities would be appropriate. In addition to such studies, off-pad activity during the sensitive period would be allowed in case of emergency.

Construction activities within the seasonal limit could also cause an unacceptable disturbance, but it would depend on the particular job to be done. Therefore construction activities during the goose molt would have to be decided on a case-by-case basis through consultation with agencies.

Road traffic could be reduced during the goose molt by limiting transportation of personnel to coincide with shift changes and suspending nonessential operations requiring vehicles other than passenger vehicles. The reduction of traffic to a very low level could allow for narrower buffers of no roads around lakes.

Draft Stipulations: Waterfowl

1. Exploration and development activities will avoid critical feeding habitat types unless otherwise accepted in consultation with BLM, FWS, NSB, and ADFG.
2. Restrict access via roads or infrastructure by public into molting area.
3. Restrict/minimize/consolidate roads and facilities to the extent possible. Intrafield roads only are preferable. We don't want roads all over the molting area.
4. Road gravel fill removed upon oil field abandonment so that roads are made unusable.
5. Buffers will be added to protect goose molting area.
6. Cross-drainage structures will be sited and maintained and properly abandoned so as to prevent impoundment or alteration of hydrology.
7. Material sites are subject to buffers and seasonal restrictions.
8. Restrict water extraction from lakes used by molting geese.
9. Facility layout shall incorporate features that screen/shield human activity from view of the closest goose molting lake.
10. Putrescible garbage needs to be handled/disposed of such that predators will not have access. Plan so that waste production is minimized.
11. Feeding of any wildlife prohibited.
12. Restrict hazardous materials to existing pads. Standard fuel storage stipulations. See existing regulations.

Seasonal stipulations, about June 15 to August 20 or 30; dates to be determined:

13. Aircraft access minimized. Helicopter overflights suspended except in emergency. Routine fixed-wing flights limited to two round-trip flights per week. Flight corridors established; designated routes that minimize disturbance to waterfowl. Generally 3 km lateral from high-use areas. Use of corridors mandatory except in emergency.
14. Off-pad activity shall be prohibited except in emergencies unless otherwise accepted in

consultation with BLM, FWS, NSB, and ADFG.

15. Construction activities suspended unless otherwise accepted in consultation with BLM, FWS, NSB, and ADFG.
16. Road traffic minimized. Transportation of personnel between camps/pad facilities limited to coincide with shift changes. Nonessential operations requiring vehicles other than passenger vehicles shall be suspended.
17. Public access via and use of oil field facilities shall be restricted.

Recommendations

1. Subsistence—process needs to be set up to manage this.
2. Enforcement?
3. Monitoring program on effects of oil development on molting geese, both pre and post. Integrated monitoring team needs to be explored.

Proceedings of the Caribou Panel

Review of Current Knowledge

Importance of the Teshekpuk Lake area to caribou:

The Teshekpuk Lake area (Figure 4) may be important to caribou as a calving ground because of fewer predators, habitat (more micro-relief where snow blows away in winter and provides for certain plant/habitat types and wider feeding options), less human disturbance, and traditional use by the herd. Overall, though, we have little information on the factors that provide good calving habitat.

It is important as a summer use area, including for insect relief and forage, due to its prevailing winds, proximity to the coast and river deltas (more wind, cooler temperatures and later emergence of insects), and for its adequate forage close to insect relief habitat. Caribou need to eat during those portions of the day when insect harassment is not so intense. The TLH ranges primarily within 30 km of the coast when insects are bad. The expenditure of energy to get away from insects, the intake of energy from browsing, and the energy expended traveling to different areas for food are important criteria in defining good insect relief habitat. No portion of the coastal area is known to be used more than others for insect relief. The caribou seem to move northward and westward when insects are bad. As for criteria of good calving habitat, we don't have adequate data on summer forage requirements and availability.

This area is also used year-round by the TLH, in contrast to the Central Arctic Herd, which uses the Kuparuk/Prudhoe area in summer only. Winter use is variable, involving 10 to 100 percent of the herd. There has been a fair amount of winter use between Teshekpuk Lake and Fish Creek, even during severe winter range conditions, which are early winter rains and heavy snow. Caribou that winter in the area get fewer lichens and more sedges in their diet during winter than some other herds in Alaska. The TLH may not be as dependent on lichen forage as other herds, because they have other options.

Recent data show that part of the TLH migrates south of the Brooks Range, but many are still using the Teshekpuk area during the winter. During the late 1970s and early 1980s, it seemed that almost all of TLH wintered in this northern area. However, they didn't have satellite collars then, so we may have had a biased view. Since winter distribution varies, there may be confusion in the future between oil industry effects and weather effects on winter migration.

Another benefit of the Teshekpuk area is the presence of relatively few predators. The prey base is not consistent enough to keep predators in the area year-round. Caribou migratory behavior is erratic and if caribou are not in the area there is nothing else for predators to eat. There may also be more hunting of predators by humans in the Teshekpuk Lake area. Wolves may move into the area temporarily, but they probably do not remain there long-term.

The TLH is the most important caribou herd for local resident hunters. People from Barrow, Wainwright, Nuiqsut, Atqasuk and to a lesser extent Point Lay and Anaktuvuk Pass use these animals. Hunting takes place wherever the people and caribou co-occur. Nuiqsut's use of the TLH is increasing due to summer herd distribution and winter snowmachine travel. As the herd is expanding farther west, Atqasuk is also using it more. Up to 10 percent of the herd is harvested annually for subsistence. Accessibility of the TLH could go up with improved access from oil field activity. Alternatively, it could decrease if developments form a barrier to travel. It is difficult to cross gravel roads with a loaded sledge behind a snowmobile. There are also social barriers: residents don't like oil companies telling them they can't hunt. There are no regulations against hunting around the Kuparuk oil field. At the Alpine field, Nuiqsut and ARCO are negotiating subsistence hunting rules. The Teshekpuk area represents easier access to hunting than the Kuparuk development.

Potential adverse impacts to caribou and habitat:

Impacts on the calving ground could include the actual loss of habitat, the functional loss of calving habitat due to caribou avoiding activity (humans, traffic, etc.), increased predation due to developments attracting predators, and more human disturbance. Within the calving area higher ground is preferred both by caribou and development, so there is a greater potential for affecting habitat. The network effect of development pads near to one another can cause avoidance of an even larger area. The result may be over-crowding on the remaining used habitat. Lastly, aircraft traffic can disturb parturient cows or cows with calves.

Development in the summer use area could impede movement along the coast and between foraging and insect relief habitats and interrupt use of insect relief habitat. However, gravel pads could also provide relief from insects. The use of manmade structures by caribou during insect season may or may not result in less efficient feeding. Caribou could also be killed in collisions with vehicles. The cumulativeness of impacts is important; if insect relief and access to forage are affected, there may be a cumulative energetic cost. As more impediments are introduced, the cost may increase to a threshold where productivity and survival are significantly reduced.

Year-round use of the area could also be affected. Disturbance could cause caribou to move around more in winter, increasing energetic costs and possibly functional habitat loss. The degree of separation between pipelines and roads can influence the accumulation of snow in drifts that create barriers to caribou. Roads by themselves can also produce snow drifts. There would be more aircraft disturbance in winter, since more and larger aircraft are used then. Because caribou are there year-round, there is more potential for hunting.

Discussion of impacts and studies from existing developments

Might caribou that see traffic during winter subsequently avoid a road during the calving period, even if traffic is prohibited then? No evidence of behavioral reaction to the roads themselves has been documented. There are cases where studies have shown caribou calving very near gravel pads, but it's a small number of animals. They tend to be in areas where there is much less activity, and relatively near operating drill sites that have very low traffic rates. Disturbance effects have been most noticed in and around major trunk roads with higher traffic rates. In the western part of the Kuparuk field, in an area of very little traffic, one pass of a truck has been sufficient to send cows and calves running pell-mell for a half-mile. So even a little traffic may be enough to elicit that behavioral response. The result is displacement of cows and calves from areas near roads. Mitigation for this has not been tested.

There is no way to avoid the behavioral sensitivity of cows and young calves to activity, so the activity should be constrained or reduced. If the desired condition is to totally avoid behavioral effects along a road, then allow no vehicle traffic during calving season. This extreme case has never been stipulated nor its effects tested. There has been too much resistance by oil field contractors and subcontractors.

How can disturbance be eliminated or reduced in an area? As a partial solution, the BLM could require unitization of fields. In state (Alaska) oil and gas lease sales, consolidation of facilities is one of the stipulations. If NPR-A development goes according to the geological scenario (one-to-a -few small oil fields), one small field could cross boundaries of tracts owned by different bidders. On state land there are companies leasing side by side, and when they unitize the field they choose one company to operate it. Depending on how BLM structures its regulations, it could have the same situation. There could be stipulations to minimize the number of facilities, such as airports.

The major oil fields on the North Slope have all been unitized, but each has been developed separately. There hasn't been a requirement that Prudhoe and Kuparuk be developed as one field. Geologically they are separate. The question becomes: should several oil fields share the same airport and other facilities? If there are dispersed fields without interconnecting roads, it would be difficult to have one airport servicing all fields. If there is no road, an airstrip is needed at least for emergency response but probably for crew changes and supplies also. But one saltwater treatment plant could serve several fields.

In terms of restricting activity, an oil field can't be shut down during calving. It's not feasible from a safety consideration, if nothing else. Currently, oil companies have a two-weeks-on, two-off work period. Would a six-week period during calving with no crew changes be reasonable? Could there be fewer grocery deliveries and less fresh food to reduce aircraft activity?

This would reduce air traffic only, because people are not going to live at all drill sites. If an oil field requires more than one pad, there has to be traffic. Completely shutting down an oil field is not an option, so neither is having no traffic at all. Perhaps during the six-week calving period traffic could be restricted to convoys at the beginning of each shift change.

How effective might monitoring caribou and controlling traffic be during calving season? There will still be traffic when caribou are not approaching the road, and cows may see the traffic and avoid that area. It might be reasonable mitigation during the summer use/insect relief period, but perhaps not effective during calving season. An option for mitigation during calving is to design an oil field to restrict the area and extent of activity, i.e., minimal number of pads, minimal length of roads, and minimal traffic. But these restrictions would also be tempered by economic concerns. The economics of these smaller fields drives what can be considered in designing them.

During the summer following calving, it would be beneficial to restrict traffic to ≤15 vehicles per hour. In the past, minimizing unnecessary traffic has been stipulated but difficult to enforce. In a sensitive area like that around Teshekpuk Lake, where large aggregations of caribou might move through an oil field, caribou monitoring and subsequent traffic control may be a more effective and responsive approach than broad-scale seasonal restrictions. If the general location of caribou is tracked, there will be days when they won't be in an area and gravel hauling or other heavy traffic could be allowed.

A different problem could be hunting from the road. One recommendation stressed by Cronin, et al. (1994), was a strict prohibition on vehicle-based hunting. As soon as caribou associate roads with hunting, they will avoid them. Hunting from the road by oil field employees can be prohibited. That can also be regulated by the Federal Subsistence Board and the Board of Game. The law already prohibits shooting from or along the driveable surface of any road, but all one has to do is literally step off the shoulder, shoot at an angle away from the road, and it's legal. In the Swanson River oil field, USFWS has a hunting stipulation that does not allow people to use vehicles within the field. Hunters can go into the field on foot and hunt but can't take a vehicle. For NPR-A, a recommendation for no hunting could be made to the Board of Game because hunting exacerbates the whole caribou disturbance issue.

The reaction of caribou to pipelines may be influenced by height, number of pipes on a rack, and separation from roads. Five feet between the ground and the bottom of the pipe at vertical support members (VSMs) appears to be a good height for an elevated pipeline. There are places over high terrain where the pipeline would be close to the ground, which may impede caribou movement. However, 60 percent of the Alpine pipeline will be above five feet because of the unevenness of the terrain. There are no data to suggest that caribou benefit from having the pipeline six feet high or higher. On the Endicott development, biologists found no selection for higher pipes by caribou. The frequency of strong reactions by caribou to elevated pipe has decreased over the years. There were some by the CAH early on, so there may be a learning curve for a herd that has never experienced elevated pipeline.

Some question remains about the relative effectiveness of ramps over pipe vs. sections of extra- high pipe (eight feet) in areas identified as crossing locations. The latter has never been tested as an alternative, but there have been several studies of ramps. They have been used more frequently than expected in relation to their availability, but that may be a function of their extremely narrow width. Statistically, almost any use of those ramps, which represent a very small proportion of pipeline length, translates to significantly above-average use. In terms of getting large caribou groups over pipes, the only place where ramps were effective was in the Prudhoe field where some pipelines are much lower than five feet. The general conclusion is that elevated pipeline alone is sufficient without stipulating ramps.

There is less experience with the evaluation of pipeline/road separations. There has been one dedicated study of that, but it was in a year of little mosquito activity so it was less conclusive than desired. Nonetheless, the initial indications were that the separation of pipelines from roads by ≥100 meters resulted in significantly more frequent crossings. This separates two elements of a development corridor (road and pipe) that appear to have synergistic effects.

Another consideration is on which side of the road should a pipeline be placed. In the Kuparak field, when caribou encounter the pipeline first they often hesitate at the pipeline. While hesitating, traffic would come by and cause further delay or deflection.

A study in the Kuparak field in the late 1980s addressed the number of pipes on a rack, separate adjacent sets of pipes on racks, and caribou crossings. Normally, caribou crossing success has been evaluated by looking at whether or not caribou approaching at a certain distance succeeded in getting through to the other side. The Kuparak study involved more behavioral monitoring and group sampling. At one place in Kuparak, there is one rack with several pipes on the south side of a road, another rack with several pipes on the north side of the road, and yet a third rack beside that. There are now caribou trails running parallel under those wide racks of pipes. Ruts are being formed in those shaded areas under the pipes, which provide fly relief habitat. Indications are that it's more difficult for caribou to cross under the pipes from one side to the other, but the data do not test this.

A possible mitigation would be to bury pipes under the roads, which has been done in the Milne Point field. The effects of that on caribou hasn't been studied, but it makes sense from the standpoint of mitigating potential delays or deflections of caribou crossings in corridors where pipe must be adjacent to the road. However, it requires more gravel, a larger area of natural vegetation must be buried, and oil spill detection is more difficult.

The average roadpad thickness is five feet. Would a three-foot roadpad be easier to cross? Sides of roads are ramped; the problem is not the physical barrier, but the visual barrier. Caribou are more apprehensive if the road is the same height as the pipeline and they can't see the other side. It also depends on the visual topography of the area. However, technological constraints may require that five-foot thickness for load-bearing capability. The problem can be partially mitigated by separating pipeline from road.

Layout of the field (whether pipes or roads run north-south or east-west) could also make a difference. Caribou movements show directional trends. Roads and pipe could be oriented in relation to the principal direction of travel by caribou groups moving to and from the coast. In parts of the Endicott corridor, caribou can still reach insect-relief habitat without needing to cross the pipeline. In the Teshekpuk area, caribou movement is much more restricted by the number and distribution of lakes. Except along the coast, movements are mostly north-south and there are caribou trails that seem to be used with great regularity. It would make sense to be aware of that and design any development accordingly. This is especially so between Teshekpuk Lake and the Kogru River, which create a natural funnel the entire herd must go through every year. Here it may be necessary to bury pipelines under roads, or even prohibit all potential barriers to movement in that area. Some lessons on caribou movement have been learned the hard way over the years in the Kuparak field. There, corraling effects of roads and pipelines created some of the worst examples of delayed and deflected movement. Loops, circles and similar designs must be avoided.

In general, mitigation studies have focused most on the insect and calving seasons. The largest concern may be the calving season. But for the Teshekpuk area, on-the-ground studies are needed to see how caribou use the area in all seasons. Such studies could be stipulated in lease agreements.

Development of Stipulations

Because caribou movement along the Beaufort Sea coast is crucial for insect relief, it would be best to establish a zone of no unnecessary permanent surface occupancy (permanent facilities) within two miles of the coastline (Figure 5). A similar stipulation was proposed for the Arctic National Wildlife Refuge during past planning efforts. Some facilities, such as seawater treatment plants, may be necessary in that zone. A needs assessment would have to be done for each proposed facility. During cumulative impacts analyses, future actions such as state offshore lease sales would have to be considered. Since establishment of this zone would push development inland from the coast, would it force development into areas that are even more sensitive? Probably not for caribou, but it may cause conflicts with the needs of molting geese.

The roughly 10-mile-wide strip between Teshekpuk Lake and Harrison Bay, and especially the corridor between the lake and Kogru River, represents an area critical for caribou movement. There are large caribou trails in this area. Another such area lies northwest of the lake, between it and Smith Bay. If oil is discovered in these areas, development should be designed so it would follow the direction of caribou movement and not impede movement in any of these corridors. Perhaps a general stipulation should be included saying that special requirements and greater scrutiny may be imposed on development in areas critical to caribou movement. Also, some facilities may have to be constructed outside the boundaries of the lease that contains an oil discovery, if a critical movement area is involved.

It is easier at this time to designate townships that encompass these movement areas, rather than trying to identify particular corridors (Figure 5). Six townships cover the majority of the area east of Teshekpuk Lake and one township is sufficient for the corridor northwest of the lake. The BLM can work with industry as they design facilities, but should make it clear up front that there will be tighter restrictions on placement of roads and facilities in those townships. In most of the area east of Teshekpuk Lake, roads should run in a north-south pattern, not east-west. In a smaller zone within those six townships, extending about four miles east from the eastern shore of the lake, there should be no permanent surface occupancy. In any of these critical movement areas pipelines may have to be buried.

To further mitigate impacts in summer use and insect relief areas, any elevated pipeline should be a minimum of five feet high at each VSM, measured between the highest point of ground and the bottom of the pipe. To reduce the number of production pads and the resulting network effect, maximum feasible extended-reach drilling should be used throughout the Teshekpuk area.

Pipelines and roads should be separated to reduce their synergistic effects on caribou movement. The greater the separation, the better it is for the caribou. Benefits of separation begin to show at 300 feet and improve out to 1,000 feet. If a strict minimum is set, The BLM may get into a corner later if the minimum is not feasible. For instance, topography may be a limiting factor.

Which side of the road the pipe is on may also contribute to the success of caribou movement. In some places caribou come from all directions, but in other places there is one direction used more frequently. This may require additional studies. For now it may be adequate to state that pipelines must be placed on the appropriate side of the road.

To reduce the disturbance by vehicular traffic on calving grounds and the summer use area around Teshekpuk Lake, traffic restrictions could include convoys, busing, caribou movement monitoring, and controlling traffic when caribou crossings are imminent.

The design and layout of oil field development should conform to caribou movement patterns to the greatest extent feasible. Planners should consider the orientation of linear corridors when laying out fields to address caribou migration and the potential corralling effect of gravel pad networks, and to avoid loops of road and pipeline that connect facilities. Such design planning would require greater knowledge of caribou movements. Studies may be required, including mapping of caribou use areas.

Just one study would not be sufficient, because caribou may change their movements in reaction to existing structures. As soon as a lessee makes a discovery, they could begin studies. However, the lessee would be designing the field right after discovery, so with this scenario the design would be based on one summer's study at best. Thorough biological studies of caribou movements and use of the area should be conducted immediately after oil and gas leases are awarded and prior to development plan design, to determine how to best locate facilities. The lessees should fund these studies through a joint state/federal/borough oversight committee.

To reduce the total number of gravel pads in a field design, all facilities except airstrips, docks and seawater treatment plants should be located on drill pads. If possible, airstrips should be integrated with roads.

To further reduce disturbance during calving and summer use periods, no seismic activity or exploratory drilling should take place in the Teshekpuk area from May 1 through September 30. Helicopters could also represent a disturbance factor at this time, but there are no data documenting their impact on caribou. Since the waterfowl panel will undoubtedly address this issue, it can be deferred to them. Also discussed but deferred are prohibitions on all construction between May 1 and June 15, and on the construction of permanent roads connecting individual fields to each other or to the road system outside NPR-A.

In small operations, it is likely there would be two or three pads connected, but only one camp. How much traffic is involved with the operation depends on the stage of development. The number of drilling operations drops off as the field matures, but maintenance continues. It would be desirable to have no traffic during calving, but given the economic reality, keeping it to a minimum would be the best possible action. This could be accomplished in part from May 20 through June 20 by limiting traffic to four convoy round trips per day between facilities. It could be further improved if drilling muds and other major equipment, materials and supplies were moved and stored at work sites at times different than the calving season, i.e. prior to and after May 20 through June 20.

The size and speed of vehicles and the size of dust plumes they produce should also be limited. Speed limits from May 20 through June 20 could be minimized to the point where no dust plumes are produced and caribou behavior is not impacted by the sight of large, speeding objects. Perhaps a convoy could be led by a water truck to hold down dust. However, it would probably be more practical just to require that traffic speed be reduced to 15 mph from May 20 through June 20.

Traffic is not the only disturbance factor that can cause parturient cows or cows with calves to avoid roaded areas. The association of hunters with roads can have the same effect. Hunting by all oil field workers should be prohibited.

Fixed-wing aircraft can also disturb calving caribou. Since Twin Otter aircraft are currently found sufficient for normal operations, it should be required that between May 20 and June 20 the use of aircraft larger than a Twin Otter be for emergency purposes only. Aircraft traffic takeoffs and landings should be limited to an average of one flight a day between May 20 and June 20 at aircraft facilities, except for emergencies.

Caribou calf survival can be affected by oilfield development if predators are attracted to the area. Putrescible waste disposal should be conducted so as to not attract calf predators. Possible methods for implementing this include bear-proof dumpsters, fenced camps, incineration, backhaul, or enclosed compost.

Draft Stipulations: Caribou

1. Any elevated pipeline will be a minimum of five feet high at VSMs, measured at VSM between highest point of ground and bottom of pipe.
2. There will be a potential for ramps, buried pipe, or pipe buried under the road where facilities or terrain funnel caribou movement.
3. Separate elevated pipeline/roads by 500 feet minimum, if feasible.
4. Place the pipeline on the appropriate side of the road to prevent delay or deflection of caribou, depending on caribou movement.
5. Traffic restrictions may include:
    - convoying
    - busing
    - caribou movement monitoring, and
    - controlling traffic when caribou crossings are imminent.
6. Consider orientation of linear corridors when laying out fields to address migration, corralling effect, and avoiding loops of road and/or pipeline that connect facilities.
7. Biological studies of caribou movements and use of area will be conducted prior to

development plan design, to determine how to best locate facilities. Lessees will fund these studies through a joint state/federal/borough oversight committee immediately after the leases are awarded.

8. There will be a zone within two miles of the Beaufort Sea coastline that will allow only necessary permanent surface occupancy. Examples of necessary will include:
    a. a staging area or causeway that requires a year-round road to the inland area,
    b. a seawater treatment plant and associated pipeline or road, or
    c. a production pad for an oil field that cannot be produced from outside the two-mile zone.

Examples of unnecessary are:
    a. airports,
    b. camps, and
    c. some processing facilities.

The burden of proof as to necessity is with the lessee.

9. Use maximum feasible extended-reach drilling for production drilling.
10. No seismic activity or exploratory drilling from May 1 through September 30.
11. Road traffic from May 20 through June 20 will be minimized (a reasonable target would be four convoy round trips per day between facilities).
12. From May 20 through June 20, traffic speed will be reduced to 15 mph.
13. Major equipment, materials, and supplies will be stockpiled at work site prior to and after May 20 through June 20 to minimize road traffic.
14. Use of aircraft larger than a Twin Otter between May 20 and June 20 will be for emergency purposes only.
15. Aircraft traffic takeoffs and landings will be limited to an average of one flight a day between May 20 and June 20 at aircraft facilities, except for emergencies.
16. Hunting by all oil field workers is prohibited.
17. All facilities except airstrips, docks, and seawater treatment plants will be located on drill pads.
18. If possible, airstrips will be integrated with roads.
19. Putrescible waste disposal will not attract calf predators, by using, for example, bear-proof dumpsters, fenced camps, incinerators, backhaul, or enclosed compost.
20. A north-south corridor between Teshekpuk Lake and Kogru Inlet is a crucial area for caribou movement.
    - buried pipeline
    - zone of no permanent surface occupancy extending four miles east from eastern shore of Teshekpuk Lake.
21. Within the designated crucial areas—the movement corridors to the east and northwest of Teshekpuk Lake—facilities placement will receive greater scrutiny.
22. Encourage off-lease site development in crucial areas.

Group Review and Synthesis of Stipulations

Review of Stipulations

Caribou Stipulations:

Both panels reconvened as one group and reviewed the 22 draft stipulations for caribou. There was a concern that the height requirement for pipelines in #1 didn't specifically address human (and snowmobile) passage under pipelines. However, this was a subsistence issue and fell outside the purview of this workshop.

The third stipulation contained a minimum distance for separation between pipelines and roads, but did not specify a maximum distance. This could be a concern if the only method of spill monitoring was visual inspection from a road-based vehicle. However, with the capability of aircraft-mounted radar for spill monitoring there would be no reason to specify a maximum distance.

The two-mile coastal buffer referred to in #8 is an area in which the panel would prefer to see absolutely no development. Since that may not be feasible under an EIS alternative that allows leasing in the entire area, this stipulation was developed so that the oil industry would understand that any development plans in that zone would be under greater scrutiny.

The requirement for maximum feasible extended-reach drilling in #9 was not tied to a specific area. It was intended to cover the entire area addressed by this workshop.

The intent of #13 was to minimize traffic during that one-month period of May 20 through June 20.

Waterfowl Stipulations:

The buffers referred to in #5 were intended to exclude all permanent facilities except pipelines. The features implied in #9 to screen the view from geese were snow fences or something similar. The restriction described in #11 was meant to apply to all animals, including gulls and ravens, which are not covered under existing law.

The restrictions on public access in #2 and #17, and on roads in #3, were developed so that new facilities would not provide additional access for the public. One concern was that people might boat to a facility and then use the facility's road system to get to other areas. However, a road between fields might be less disturbance overall than separate facilities for each small oilfield.

There was considerable discomfort among the group regarding how vague both sets of stipulations were on just how extensive a road network might be built in the Teshekpuk Lake area. It was obliquely referenced in #7 of the caribou stipulations. Could that be expanded to say "roads in this area will not be connected together to the extent possible"? If #3 of the waterfowl stipulations was changed to remove "molting" so that it would apply as well to the entire caribou area, it might be the best that could be done without knowing where and what types of development would be needed.

Resolution of Conflicts Between the Sets of Stipulations:

There was concern that #1 and #5 of the waterfowl stipulations might push development into areas that are critical to caribou. The specific habitat addressed in waterfowl #1 is immediately adjacent to lakes. Both #1 and #5 of the waterfowl stipulations need additional GIS analysis to delineate those areas in the document. There may not be an actual conflict.

Waterfowl #2 was eliminated since it was covered by #17. Waterfowl #16 limits vehicle traffic to two shift changes per day, whereas the caribou panel suggested no more than four round trip convoys each day. These two stipulations address two time periods that barely overlap. During the overlap period the more restrictive should apply. The same could be done for seasonal restrictions on fixed-wing aircraft where they overlap in time and area.

Does the restriction on helicopter flights in waterfowl stipulation #13 mean that no wildlife surveys could be done by helicopter during that time? These stipulations would apply only to oil and gas lessees, not to agencies. However, there might be the impression of an unfair double standard; agencies should coordinate better in the future to ensure that helicopter flights during that period are the minimum necessary for mission accomplishment.

A better definition of prohibited construction activities should be included in waterfowl #15. It was meant to limit construction activities using heavy equipment. Drilling rigs should be excluded from the definition of heavy equipment.

Residual Impacts

The final goal of the workshop was to determine what the residual impacts to wildlife would be, given the application of the above stipulations. However, this question could not be resolved because there was not adequate quantitative information for either caribou or molting geese. Residual impacts could only be described in a qualitative manner.

Since there is practically zero tolerance for human activity in a caribou calving area, the result of any development would be some displacement of calving caribou. The extent of this cannot currently be quantified and it is unknown if it would translate into population loss. There are recent data from the CAH that suggest that it might.

Neither the number of molting geese that might be displaced nor the energetic costs of that displacement can be estimated. In general, the result of development would be the disruption of caribou movements, some localized displacement of molting geese and calving caribou, and some harassment of caribou and geese. Finally, given the lack of energetic tolerances, there would likely be energetic stress, increased mortality and decreased productivity in caribou and geese.

Buffer Widths for Goose Molting Lakes

On May 28, 1997, Philip Martin, Anne Morkill, Jack Winters, Dave Yokel and BLM's GIS specialist Tim Hammond met to discuss the buffers around lakes used by molting geese. Several assumptions and guidelines were first established:

- Pipelines within buffers would not negatively impact molting geese.
- Goose foraging habitat extends up to 100 m from lake edges.
- The disturbance effect of vehicle traffic lessens at distances over 400 m.
- No study has shown a lessening of the disturbance effect of foot traffic at distance. This phenomenon has not been studied at distances greater than 1000 m, although some anecdotal observations have been made during other studies.

Using GIS technology, several options for buffers were investigated with the goals of providing geese adequate protection based on the above assumptions while still allowing the development of any discovered oil fields. The most reasonable solution found for satisfying both goals was a two-step approach. A 500 m buffer would be established around all goose molting lakes. Only pipelines would be allowed within that buffer. In addition, a 1000 m buffer would be established around those lakes that cumulatively account for at least 80% of the molting brant, and 50% of each of the other three species. Within the area between 500 m and 1000 m of these lakes, roads and production-only pads would be allowed, but all other facilities, including airstrips, would not. By the above goose population percentage criteria, this additional buffer was applied to 40 lakes that account for 83% of the brant, 69% of the Canada geese, 58% of the greater white-fronted geese, 75% of the snow geese and 73% of all geese combined.

Since it was recognized that these stipulations might preclude the development of some oil fields, depending on their location, depth and orientation, it was decided to include the provision that in such a situation exceptions might be made by the BLM in consultation with the USFWS.

Development of a Combined Set of Stipulations

On June 2, 1997, a teleconference to merge the caribou and waterfowl stipulations was attended by panelists Jim Craig, Joe Dygas, Don Hansen, Philip Martin, Anne Morkill, Tom Rothe, Dick Shideler, Jack Winters and Dave Yokel. Also participating were workshop attendees Phyllis Casey, Marie Crosley, Jim Ducker, Johanna Munson, Mark Myers, Dick Roberts, Pam Rogers and Curt Wilson. Each of the two sets of stipulations were separated into categories (see below) to expedite comparisons. A single set of stipulations with no redundancy and presumably no contradictions was developed from these. This list represents the final recommendations of the workshop panelists to the BLM for the management of oil and gas development in the Teshekpuk Lake area, should it occur.

The area that encompasses the caribou calving and summer use areas is larger than, and includes in its entirety, the area that encompasses the lakes used by molting geese. If any of the stipulations listed below is meant for the goose area only, it is so noted. Those stipulations that are meant to protect caribou may in some cases increase the potential impacts to molting geese, and vice versa. This cannot be ascertained until the design plans for a specific development project are drafted, which won't take place unless an economically developable oil field is discovered in the future. At that time the BLM, in consultation with the USFWS, shall decide how to resolve any conflict between two or more stipulations.

Final Workshop Stipulations

Biological Studies:

1. Immediately after leases are awarded, to allow completion prior to development plan design, conduct studies of caribou movements and use of the area to determine how to best locate facilities. Lessees shall fund these studies in proportion to acreage leased. The studies shall be designed and the ensuing work awarded through a joint state/federal/borough oversight committee.

Oil Field Design:

2. All goose molting lakes (Figure 6) shall have buffer zones of 500 m surrounding the lakes. Within these buffers no permanent structures, excluding pipelines (e.g., roads, pads, airstrips, material sites), shall be located. High use lakes (Figure 6) shall have a 1,000 m buffer zone within which no permanent structures, excluding pipelines, shall be located. If the above restrictions preclude development, exceptions shall be made by the BLM in consultation with the USFWS. Exceptions may also be granted if other alternatives are demonstrated environmentally preferable.

3. There will be a zone within two miles of the Beaufort Sea coastline (Figure 5) in which only necessary permanent surface occupancy will be permitted. Examples of necessary include, but are not limited to: 1) a staging area or causeway that requires a year-round road to the inland area; 2) a seawater treatment plant and associated pipeline or road; 3) a production pad for an oilfield that cannot be produced from outside the two-mile zone. Examples of unnecessary are: 1) airports, 2) camps, and 3) some processing facilities. The burden of proof as to necessity is with the lessee when a development plan is submitted to the BLM.

4. There are two narrow land corridors between Teshekpuk Lake and the Beaufort Sea (northwest and east of the lake; Figure 5) that are crucial caribou movement corridors. Within these two areas:
    a. Facilities placement will receive greater scrutiny by BLM during development plan design.
    b. Off-lease site development would be encouraged if it would reduce development within a crucial area.
    c. Burial of pipelines may be required.
    d. There will be a zone of no permanent surface occupancy extending four miles east from the eastern shore of Teshekpuk Lake in the area between the lake and Kogru Inlet.

5. Use maximum feasible extended-reach drilling for production drilling to minimize number of pads and the network of roads between pads.

6. All facilities except airstrips, docks and seawater treatment plants will be co-located with drill pads. Exceptions may be granted or required by the BLM, in consultation with the USFWS, if a development is permitted within 1000 m of a high-use goose lake.

7. If possible, airstrips will be integrated with roads.

8. Orient linear corridors when laying out fields to address migration and corraling effects, and to avoid loops of road and/or pipeline that connect facilities.

9. Exploration and development activities will avoid alteration of critical goose feeding habitats (grass/sedge/moss) along lakeshore margins (Figure 3).

10. Facility layout shall incorporate features (e.g., temporary fences, siting/orientation) that screen/shield human activity from view of any goose molting lake within 3 km.

11. Cross-drainage structures will be sited, maintained, and properly abandoned to prevent impoundments or alteration of local or areawide hydrology.

12. Any elevated pipeline will be a minimum of 5 ft high at VSMs, measured at VSM between highest point of ground and bottom of pipe.

13. Ramps, buried pipe, or pipe buried under the road may be required where facilities or terrain funnel caribou movement.

14. Separate elevated pipeline from roads by 500 ft minimum, if feasible. Examples of where it might not be feasible: narrow land corridor between lakes; and where pipe and road converge on a drill pad.

15. Place the pipeline on the appropriate side of the road (depends on general caribou movement in that area) to minimize delay or deflection of caribou.

Vehicle Traffic:

16. Traffic restrictions will be required from May 20 to Aug 20:

a. May 20 through June 20:

1. Traffic speed will be reduced to 15 mph.

2. Traffic minimized (a reasonable target would be four convoy round trips per day between facilities). Nonessential operations requiring vehicles shall be suspended during this time period.

b. May 20 through August 1:

1. Caribou movement monitoring

2. Traffic cessation when caribou crossings are imminent.

c. May 20 through August 20:

1. Convoying

2. Busing of personnel

d. June 21 through August 20 (goose area only; Figure 2):

1. traffic minimized (a reasonable target would be four convoy round trips per day between facilities). Nonessential operations requiring vehicles shall be suspended during this time period.

17. Major equipment, materials and supplies will be stockpiled at each worksite prior to and after the period May 20 through June 20 to minimize road traffic.

Aircraft Traffic:

18. Use of aircraft larger than a Twin Otter from May 20 through August 20 will be for emergency purposes only.

19. Helicopter overflights within the goose molting area (Figure 2) will be suspended from June 15 through August 20.

20. Fixed-wing aircraft take-offs and landings will be limited to an average of one flight a day from May 20 through June 20 at aircraft facilities. Within the goose molting area (Figure 2), fixed-wing aircraft flight shall be further restricted from June 15 to August 20:

a. limited to 2 round-trip flights/week;

b. restricted to flight corridors established by BLM in consultation with the USFWS.

Human safety and emergencies take precedence over these restrictions.

Garbage:

21. The handling and disposal of putrescible waste shall be accomplished in a manner to prevent the attraction of wildlife.

Other Activity:

22. No seismic activity or exploratory drilling from May 1 through September 30.

23. Water extraction from lakes used by molting geese (Figure 2) shall not alter hydrological conditions that could adversely affect identified goose feeding habitat along lakeshore margins.

24. Major construction activities (e.g., sand/gravel extraction and transport, pad construction, but not drilling) shall be suspended in the goose molting area (Figure 2) from June 15 through

August 20 unless approved by the BLM.

25 Off-pad activity, including humans on foot, shall be prohibited in the goose molting area (Figure 2) from June 15 through August 20 except in emergencies, unless approved by the BLM.

26. Feeding of wildlife (including gulls and ravens) shall be prohibited.

27. Hunting by lessees' employees and/or by employees of lessees' agents, contractors and subcontractors shall be prohibited.

28. Public access to goose molting areas by way of or through the use of oil field facilities shall be prohibited.

Oil Field Abandonment:

29. Roads, airstrips and other gravel fill shall be removed upon field abandonment so as to render them unusable for enhanced access into the area.

Suggested References

Caribou:

Cameron, R.D., E.A. Lenart, D.J. Reed, K.R. Whitten and W.T. Smith. 1995. Abundance and movements of caribou in the oilfield complex near Prudhoe Bay, Alaska. *Rangifer* 15:3-7.

Cronin, M.A., W.B. Ballard, J. Truett and R. Poliard, eds. 1994. Mitigation of the effects of oilfield development and transportation corridors on caribou: final report to the Alaska Caribou Steering Committee. unpubl. rept. by LGL Alaska Research Assoc., Anchorage, AK. 113 pp.

Smith, W.T., R.D. Cameron and D.J. Reed. 1994. Distribution and movements of caribou in relation to roads and pipelines, Kuparuk Development Area, 1978-1990. *ADFG Wildl. Tech. Bull.* 12. Juneau, AK. 54 pp.

Waterfowl:

Anderson, B.A., S.M. Murphy, M.T. Jorgenson, D.S. Barber and B.A. Kugler. 1992. GHX-1 waterbird and noise monitoring program. Final Report prepared for ARCO Alaska Inc. Anchorage, Alaska, by Alaska Biological Research, Inc. and BBN Systems and Technologies Corp. 132 pp.

Burgess, R.M., J.R. Rose and A.A. Stickney. 1994. 1991 Endicott Environmental Monitoring Program Final Report. Snow Goose. Final report prepared by SAIC, Anchorage, AK, for U.S. Army Corps of Engineers, Anchorage, AK. v.p.

Dirksen, D.V., K.S. Bollinger, D. Esler, K.C. Jensen, E.J. Taylor, M.W. Miller, M.W. Weller. 1992. Effects of aircraft on behavior and ecology of molting black brant near Teshekpuk Lake, Alaska. Final Report. U.S. Fish and Wildlife Service, Alaska Fish and Wildlife Research Center, Anchorage, AK. 227 pp.

Johnson, S.R. 1994. The status of lesser snow geese in the Sagavanirktok River delta area, Alaska, 1980-1993. Report by LGL Alaska Research Associates, Inc. for BP Exploration

(Alaska) Inc., Anchorage, AK. 42 pp.

Murphy, S.M. and B.A. Anderson. 1987. Lisburne Terrestrial Monitoring Program. The effects of the Lisburne Development project on geese and swans, 1985-1989. Final report prepared for ARCO Alaska Inc., Anchorage, AK, by Alaska Biological Research, Fairbanks, AK. 151 pp.

Stickney, A.A. and R.J. Ritchie. 1996. Distribution and abundance of brant (*Branta bernicla*) on the central arctic coastal plain of Alaska. *Arctic* 48:44-52.

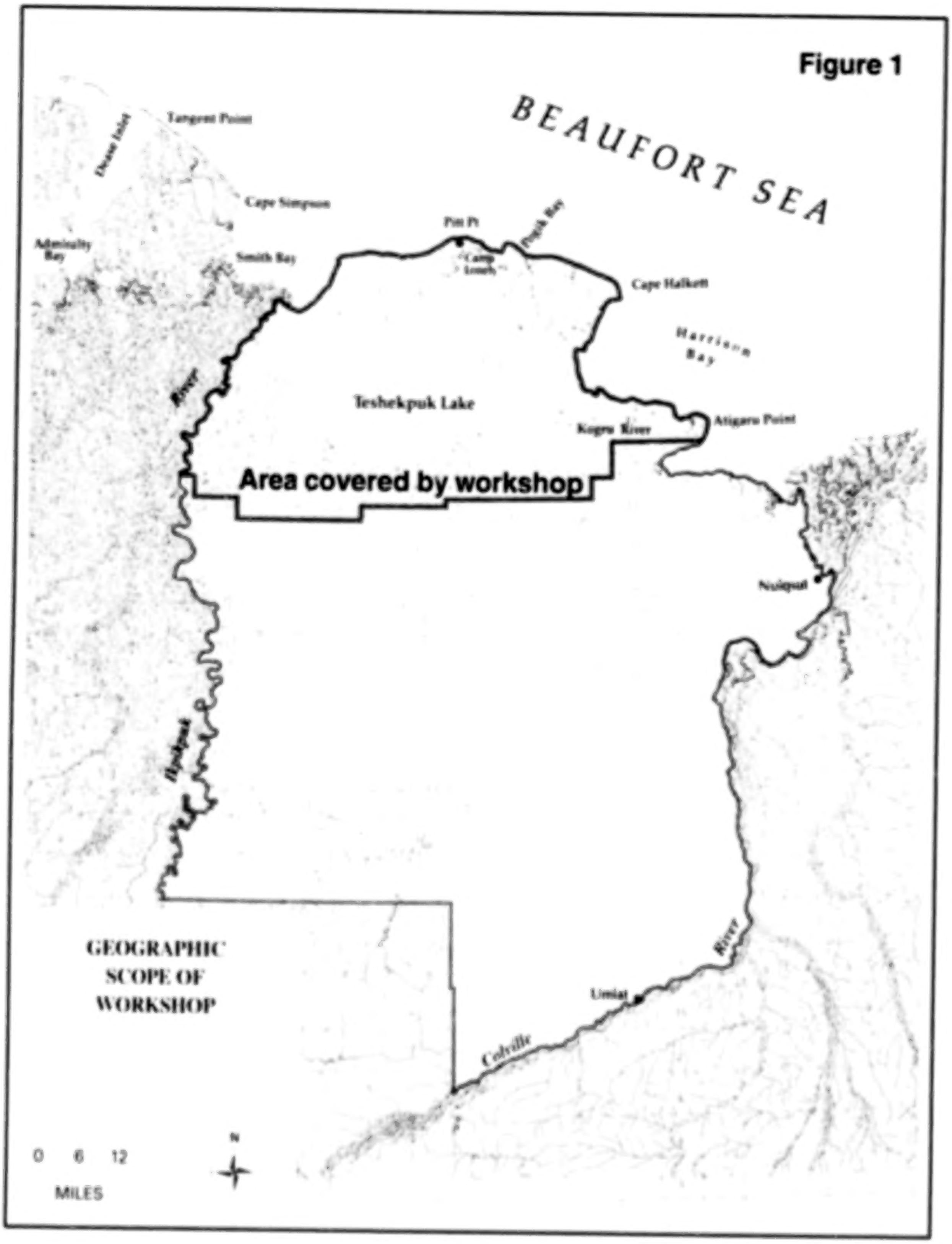
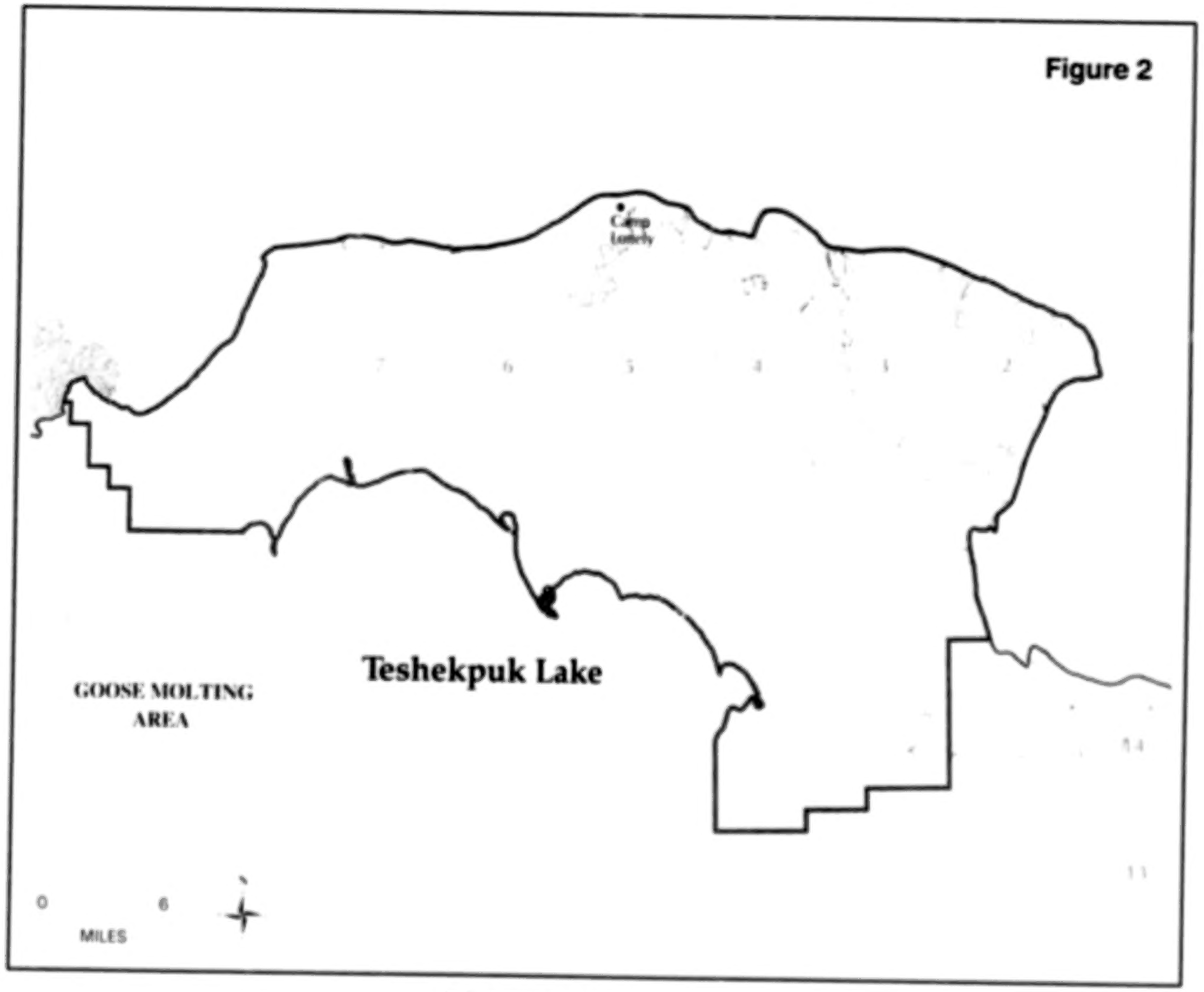


Figure 1

BEST COPY AVAILABLE

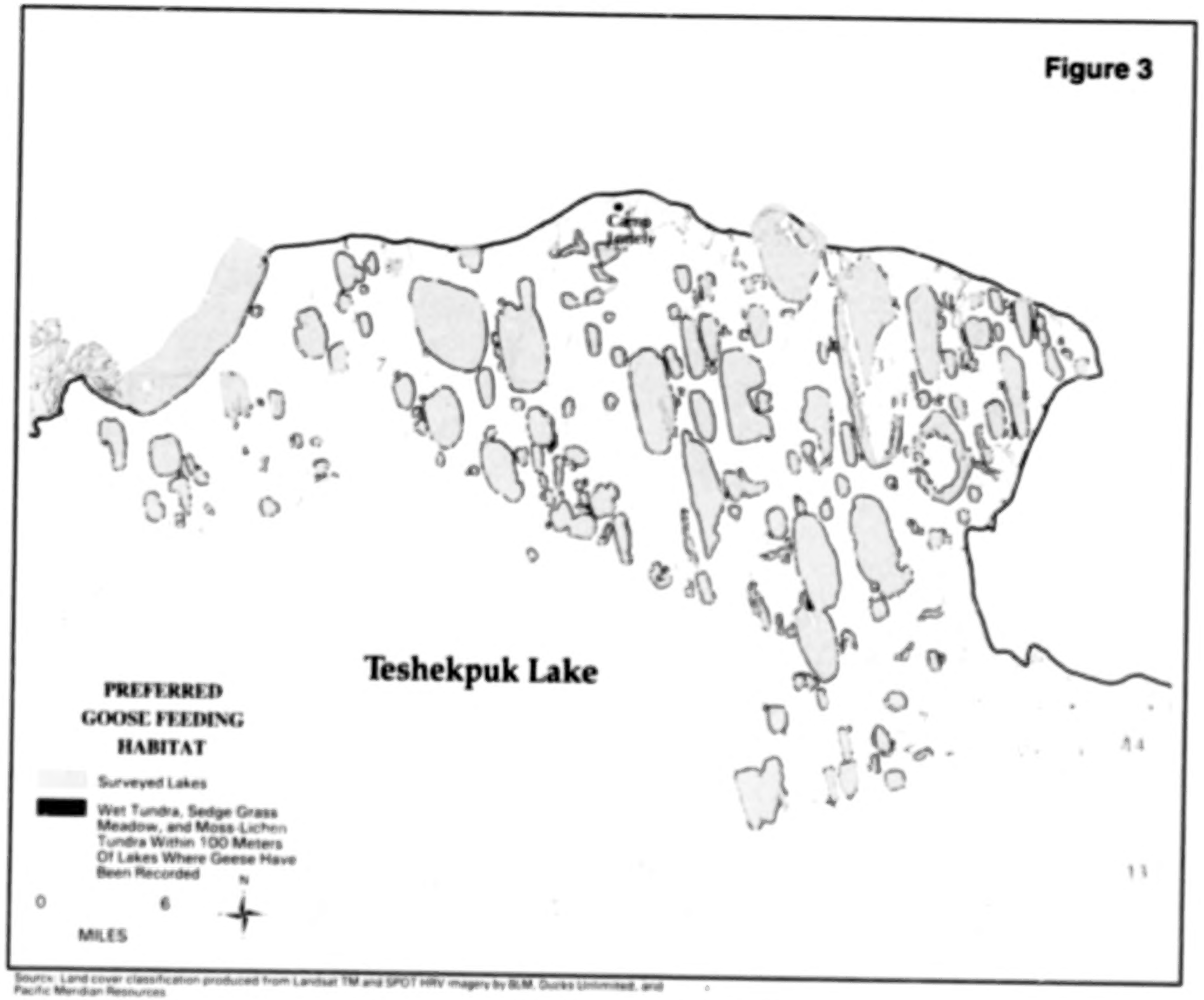
BLANK PAGE

Figure 2



BEST COPY AVAILABLE

Figure 3


Camp Lonely
Teshekpuk Lake
PREFERRED GOOSE FEEDING HABITAT
Surveyed Lakes
Wet Tundra, Sedge Grass Meadow, and Moss-Lichen Tundra Within 100 Meters Of Lakes Where Geese Have Been Recorded
N
0
6
MILES

Source: Land cover classification produced from Landsat TM and SPOT HRV imagery by BLM, Ducks Unlimited, and Pacific Meridian Resources

BEST COPY AVAILABLE

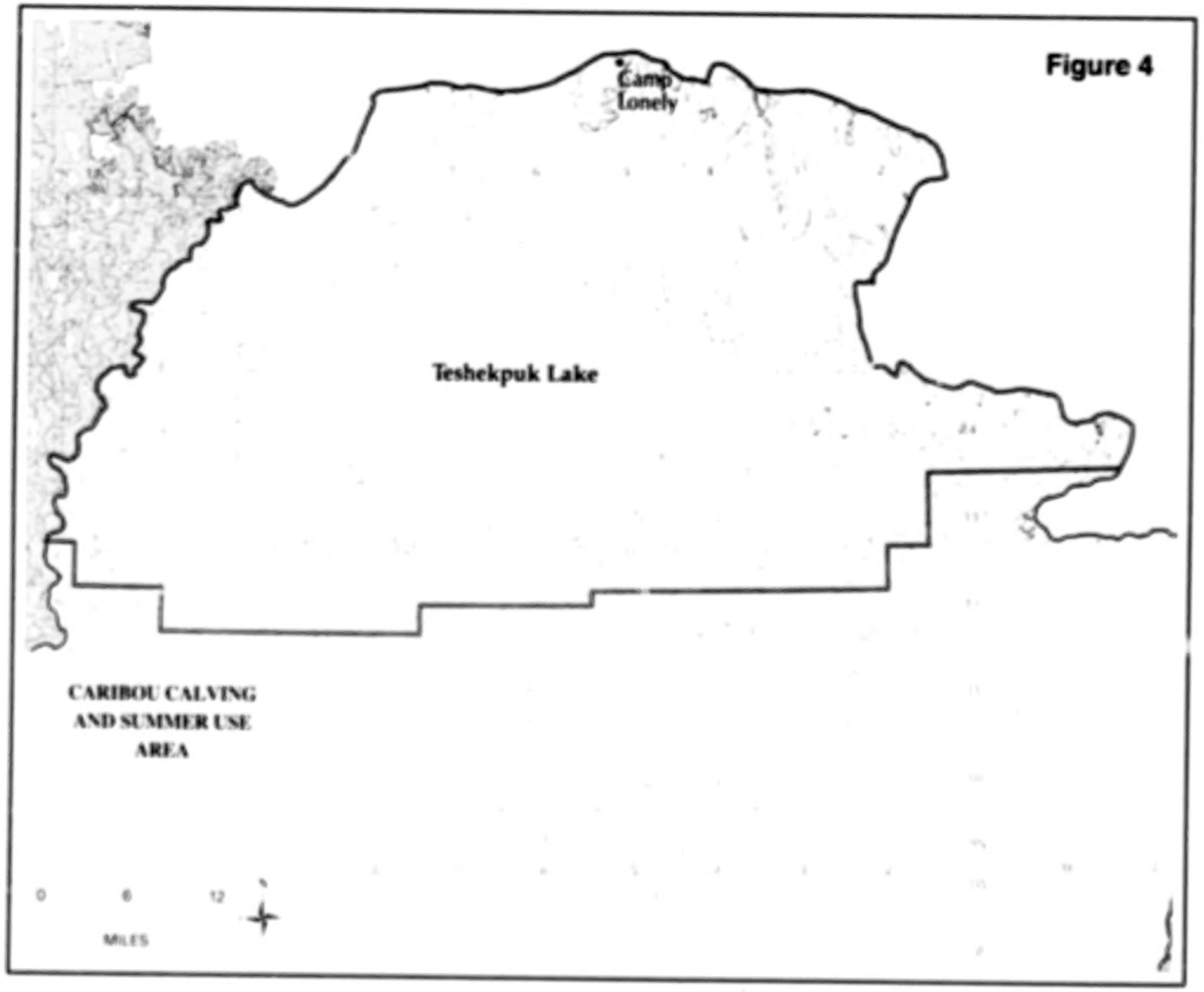


Figure 4

BEST COPY AVAILABLE

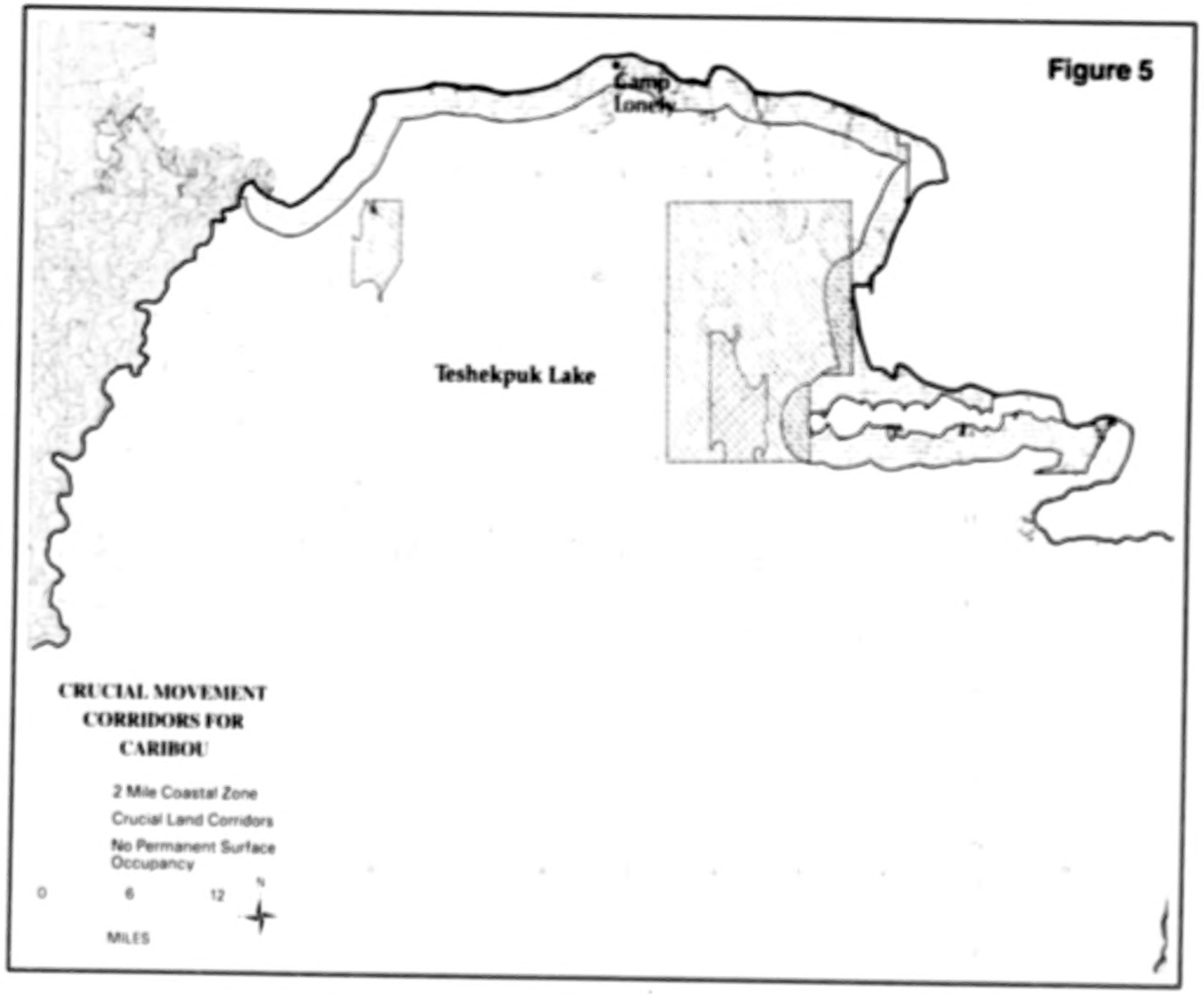


Figure 5

CRUCIAL MOVEMENT CORRIDORS FOR CARIBOU

BEST COPY AVAILABLE

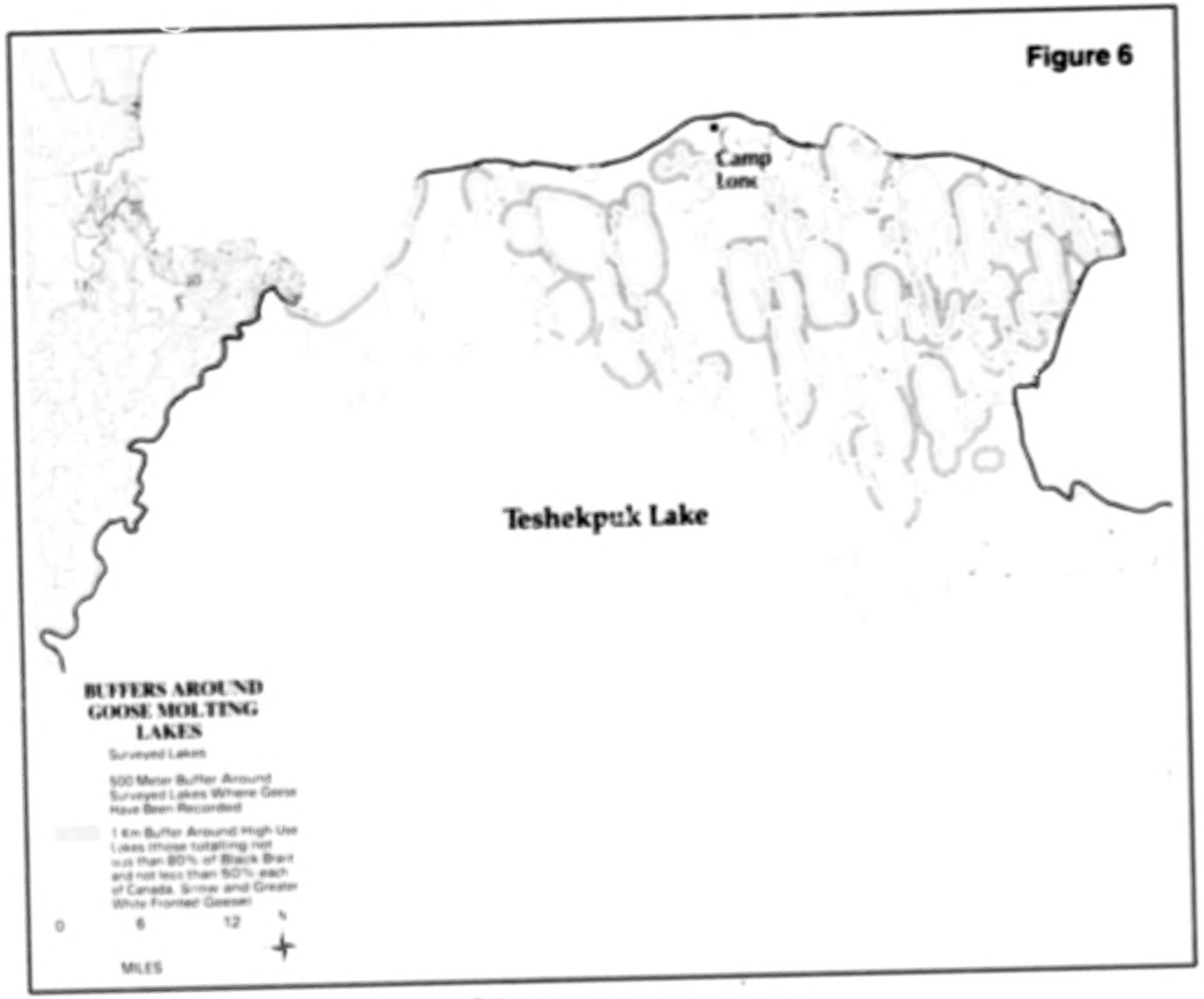


Figure 6
Camp Lonc
Teshekpuk Lake
BUFFERS AROUND GOOSE MOLTING LAKES
Surveyed Lakes
500 Meter Buffer Around Surveyed Lakes Where Geese Have Been Recorded
1 Km Buffer Around High Use Lakes (those totalling not less than 80% of Black Brant and not less than 50% each of Canada, Snow and Greater White Fronted Geese)
0
6
12
MILES
N

BEST COPY AVAILABLE

Appendix A

Teshekpuk Lake Area Development Questions

The questions below refer to an assumed economically viable oil field in the Teshekpuk Lake area. This is the northern portion of the NPR-A planning area, bordered by the Ikpikpuk River on the west, the Beaufort Sea on the north and east, and approximately north latitude 70 degrees, 20 minutes, on the south.

Oil field Design

- What level of processing would be needed? For example, will CPFs, Waterflood STPs, CGFs, etc. be needed, or could enhanced recovery be handled from the Kuparuk or Alpine field? How much development triggers necessity for these facilities? What are the considerations in locating processing facilities remote from production pads?
- Would oil field support infrastructure similar to Deadhorse be required? If not, how would support services (e.g., mud contractors, tool services, logging and cementing,) be provided ? How much development triggers a requirement for a service center in NPR-A? Would the industry look to private sources (for example a KIC-type development on Arctic Slope Regional Corporation land) for support service center?
- Under what circumstances would a dock or other facilities along the Beaufort Sea coast be considered? Address two scenarios: onshore development within the NPR-A planning area and potential offshore development.
- Would a jet airport be required, or could transportation needs be met with a smaller runway or with no airport?
- How would other drainages (e.g., Fish Creek) be crossed?
- How feasible is the use of horizontal drilling (sensu Niakuk) to reduce pad density? What factors (e.g., geological, economic) affect pad density and the potential use of horizontal and directional drilling?
- Is an oilfield without inter- and intra-connecting roads feasible?
- What are the trade-offs on elevating a pipeline 8 ft instead of 5 ft?
- Given the experience on the Badami project, are buried pipelines feasible?
- Would existing DEW-line sites at Kogru and Lonely be given priority as sites for oil and gas facilities?

Operations

Three levels of "reduced activity" are conceivable:

- Complete shut-in during the caribou calving/insect-relief and goose molting periods (May through mid-August.)
- Remote operation of production wells, with no humans on-site except in emergency.
- Minimally staffed production sites, with reductions in access (aircraft and vehicular) and suspension of drilling, well maintenance (e.g., work-overs) and other high-disturbance activities.

Compare the pros and cons of these scenarios. What sorts of seasonal shutdown or activity restrictions are feasible for constructing and operating oil fields? What risks/costs are entailed in remote operation of production wells? If production wells are not road-accessible, would there be a need to have operators flown in and out during the June-July period? Is it possible to house a small crew on the pad and commute from a remote site? How often would crews change out? What are the safety/environmental risks associated with lack of road access?

- Would industry close the oilfields to public access?
- How could solid waste collection, storage, transfer and disposal be handled to eliminate access to garbage by wildlife (bears, wolves, foxes, gulls, ravens) that may result in localized high populations of these predators? What can be done to improve current practices, and to enforce existing regulations?
- Where will gravel for construction come from? Are there alternatives (e.g., sand) that are feasible?
- What restoration strategies would be considered upon cessation of use, especially considering the importance of reduced human presence in the area, long-term?
- Would industry consider sharing seismic data gathered from one program, to avoid multiple seismic operations over the same area?

Appendix B

Molting Geese in Teshekpuk Lake Area
and
Migratory Birds of the Arctic Coastal Plan

(From surveys conducted
by
U.S. Fish and Wildlife Service,
Migratory Bird Management,
Fairbanks, Alaska)

Aerial surveys of the Arctic Coastal Plain (ACP) have been conducted intermittently since 1977. Emphasis has been on waterfowl and related waterbird species. Initial surveys on the NPR-A were conducted by Rodney King during 1977 and 1978 and resumed on all waterbird habitats on the Arctic Coastal Plain in 1986. These surveys documented the importance of the Arctic Coastal Plain to northern pintail, oldsquaw, scoter and eider ducks as well as white-fronted geese, tundra swan and loons. From 1982 to present, aerial surveys have also been conducted on selected lakes in the Teshekpuk Lake area. These annual surveys during mid-July have documented the continued use by molting black brant, greater white-fronted geese, Canada geese and lesser snow geese. These surveys across the Alaska Arctic continue to record the importance of the area to many breeding and molting migratory birds.

The annual survey of molting geese in the Teshekpuk Lake area has documented a 15-year mean of 17,570 black brant, 13,001 Canada geese, 7,024 greater white-fronted geese and 232 lesser snow geese. Total average goose use for the 199 lake areas surveyed is 37,827 annually. This data emphasizes the importance of the area not only locally, but continentally.

Arctic Coastal Plain survey lines have been positioned to give statistically valid samples that verify the importance of arctic areas to migratory birds. The current 11-year survey has documented an average of 230,000 Northern pintail, 122,000 oldsquaw, 32,000 scaup, 12,000 scoter, and more than 20,000 eider ducks, as well as 105,000 greater white-fronted geese, 8,000 tundra swan and more than 30,000 loons. Significant proportions of these species habitually use the NPR-A and the Northeast Planning Area. It is incumbent that these habitats are identified and their integrity preserved for continued use by all migratory birds.

APPENDIX F

Northeast NPR-A Integrated Activity Plan EIS Subsistence Impact Analysis Workshop Proceedings

BLANK PAGE

Introduction: The Bureau of Land Management (BLM) is preparing an Integrated Activity Plan Environmental Impact Statement (IAP/EIS) for the northeast portion of the National Petroleum Reserve-Alaska (NPR-A). The BLM convened an intergovernmental panel of technical specialists and community representatives on August 19-21, 1997, in Nuiqsut to listen to community concerns about the potential for oil exploration, development, and production activities in the 4.6- million acre northeast planning area. The workshop panel's task was to develop recommendations for BLM's consideration to protect subsistence users and uses in the planning area. The BLM will evaluate the recommendations in light of administrative and legal constraints and incorporate a set of adopted recommendations into the Draft IAP/EIS for public review and comment. These proceedings summarize public comments heard during three community meetings in Nuiqsut and Barrow, panel discussions and brainstorming ideas, and final recommendations.

Background: On February 13, 1997, BLM published a Notice of Intent (Notice) to prepare the Northeast NPR-A IAP/EIS. The Minerals Management Service (MMS) was engaged by BLM to assist in preparing the IAP/EIS. In addition to initiating a public scoping period to identify issues for the environmental analysis, BLM and MMS sponsored an NPR-A Symposium on April 16-18, 1997, to review the most current information on resources and their uses in the planning area and the potential impacts that may be incurred from various land use activities (MMS, 1997). More than two dozen speakers from various government agencies, academia, industry, and private consulting companies gave presentations during the 3-day symposium held in Anchorage, which was open to the public and attended by more than 130 people. Panelists of the North Slope Village Subsistence and Socioeconomics section made several recommendations concerning subsistence as a critical issue to be addressed in the IAP/EIS (George, 1997), including one to evaluate the effectiveness of current Federal and State subsistence mitigating measures associated with oil exploration, development, and production activities and to determine if additional measures were needed to adequately protect subsistence users, uses, and resources. The BLM consequently convened two workshops, one to develop stipulations for waterfowl and caribou resources in the Teshekpuk Lake area and a second to specifically address subsistence uses and users in the planning area. These proceedings resulted from the second workshop.

The Teshekpuk Lake Waterfowl/Caribou Impact Analysis Workshop was held May 21-22, 1997, in Fairbanks to provide BLM with various recommendations for effective design features, seasonal closures, and surface occupancy restrictions in areas critical to waterfowl and caribou (BLM, 1997). While these recommendations addressed important subsistence resources, subsistence users, uses, and access were important elements that were not addressed during the first workshop. Staff from BLM, MMS, State of Alaska, and NSB subsequently held several meetings in June and July 1997 to discuss proposals for a second workshop specifically addressing subsistence. Key points of consensus were that a subsistence workshop should be held as early as feasible during the planning process to incorporate findings into the draft IAP/EIS, and that the workshop should take place on the North Slope to facilitate input by local communities that practice customary and traditional subsistence activities in the planning area. The workshop was subsequently scheduled for August 19-21, 1997, in Nuiqsut, with public meetings scheduled in Nuiqsut and Barrow.

Workshop Format: A 13-member, intergovernmental panel of technical experts and community representatives was established to achieve the goals of the workshop. Members were selected based on their knowledge of subsistence resources and uses on the North Slope with input from local community members. Due to the legal requirements of the Federal Advisory Committee Act (FACA) and the Unfunded Mandates Reform Act of 1995 (which amended FACA), the panel had to be comprised of elected officials or their designees. Designees were employees of Federal, State, local or federally recognized tribal governments. Community representatives were employed by the NSB and also represented their communities on the NSB's Fish and Game Management Committee. Because of the legal limitations, the workshop agenda also included public sessions so that the general community (individuals and representatives that do not directly represent government agencies) could provide the panel with input on the topic. The panel below considered the public comments during their discussions on developing management practices and design features for protecting subsistence uses and activities.

BLM Wildlife/Subsistence - Dave Yokel
MMS Socioeconomic Analysis - Michael Baffrey
MMS EIS Team Representative - Paul Stang

- Are impact funds available for Nuiqsut? Can they be directed towards community - most impacted? State can grant funds to offset impacts.
- Community is already impacted - why do we have to apply for a grant?
- At certain times fish disappear, contaminants destroy habitat, displace fish. Smoke has removed and scared caribou. They run away - feel threatened. Abnormal events affecting their harvest.
- Migration of caribou may be altered near development, during seismic testing. Waterfowl may be affected by oil slicks. Don't know why ptarmigan are missing - contaminants? Pipeline may obstruct movement of animals - look at known migration patterns.
- Alternatives don't provide for protecting a human life.
- If development occurs there should be no boundary identified to prohibit subsistence - want coexistence between development and subsistence activities - leave it open.
- Too high value being put on animals, birds and fish, and not enough on humans.
- Don't feel listened to - for 29 years saying same thing - for example - musk ox. Don't see information being used.
- Influx of muskox makes caribou move. Need to manage musk ox to enhance caribou, see them as serious threat to caribou, main resource for North Slope.
- Preferred hunting area for wolf and caribou near Ikpikpuk River and Teshekpuk Lake - will reduce hunting opportunity. If drilling, go west of Ikpikpuk River - not most preferred area.
- Mounds of gravel and pads impact land - don't want them left.
- Don't want mass development to extent seen at Prudhoe Bay.
- Exploration take place west of Ikpikpuk River.
- Previously (back to 1930's) there were many more animals. Now that there are muskox, have to go hunt further to get caribou. Caribou are not coming to traditional hunting areas.
- Need to protect family's use of traditional areas - protect allotment areas.
- Want subsistence oversight panel to oversee oil and gas activities - not to take away any agency's authority, but to monitor and communicate concerns with recommendations. Want NPR-A team to recommend the oversight panel - funding is critical to assure its success.
- Community is soliciting funding for Kuukpik oversight panel - $60,000 is not enough. Incorporation papers and bylaws are being drafted.
- Want guarantee that existing camps and related subsistence use areas are protected - not taken away and told to move by government.
- Use Alpine oversight panel to cover NPR-A.
- Prefer that traditionally used areas be excluded from development.
- Get educational material to community on how to apply for grants to obtain impact funds.

Panel Discussions in Nuiqsut: The workshop panelists reconvened at the Kisik Community Center on August 20, 1997, to discuss the information they heard from Nuiqsut residents the previous evening, to review sample subsistence stipulations from previous State and Federal leasing programs, and to begin drafting management practices and design features for protecting subsistence users and uses. Panelists began by sharing their impressions about what they heard expressed by Nuiqsut residents:

- They feel that 18 months is too short.
- Community needs assistance with grant writing.
- Community is tired of meetings and giving same information.
- Community wants to increase hunter access.
- Community wants to protect existing access.
- They feel frustration with increasing restriction on access.
- Extremely thoughtful comments and repetition of basic concerns.
- Lack of human resource in community to analyze documents and represent local concerns. The NSB needs to provide assistance.
- Community wants to be assured of protection of basic subsistence lifestyle. Theme continues to be paramount over years - should be foundation of all mitigation. Community doesn't have resources to influence policy or take advantage of opportunity for funding, such as grants.
- Northeast corner is rich in subsistence resources and community wants it protected. Have used resources

1. Subsistence Advisory Panel

    Purpose/Responsibilities

    - Enhance subsistence livelihood in light of NPR-A development.
    - Keep community informed about regulations and management authority.
    - First line conflict resolution.
    - Advise BLM in its handling of development in NPR-A to assure least possible impact on subsistence.
    - Establishment of historic trends and subsistence use patterns and monitor effects of development.
    - Identify potential conflicts.
    - Provide recommendations concerning planning, research, monitoring, and assessment activities needed to facilitate responsible development of the northeast portion of NPR-A.
    - Planning - panel works with BLM in planning development process.
    - Membership - interagency including community representatives.
    - Form panel as early as possible following decisions on options discussed in IAP/EIS.
    - Where does potential lessee fit in? Invited to participate in IAP/EIS process same as other interested parties. Industry and panel would interact when proposal to do exploration and/or development is received.
    - Membership of panel should be limited to local residents (most directly affected) - Nuiqsut, Barrow, Atqasuk, Anaktuvak Pass.
    - Work with industry as early as possible.
    - Keep adjoining communities informed.
    - Need repository of information available to advisory panel. Need authority to solicit information and request analysis.
    - Agencies monitoring lessee must be required to respond to recommendations of panel.
    - Continuity and consistency in collection of information and it's use among several subsistence advisory panels. Clearinghouse function look at all activities affecting subsistence.
    - Kuukpik oversight panel covers same concerns by same local residents - recommend using that body and agreement to serve NPR-A.
    - Kuukpik Oversight Panel mission statement appears to address all the concerns and ideas identified for the NPR-A subsistence advisory panel.
    - Concern for how all advisory panel and agencies inter-relate how research is done and used.

    Authority

    - Would derive from FACA.
    - Panel would make recommendations to BLM.

    Membership

    - Make as broad as possible to help assure panel recommendations are more likely to be acceptable to BLM.
    - Regulatory agencies including tribal organizations.
    - Consider using Kuukpik Oversight Panel to address issues on NPR-A?

    Funding

    - [Public Law] 93-638.

2. Access

    - As development occurs, access to traditional areas needs to be protected.
    - BLM has a legal responsibility to provide reasonable access:
        a) free passage for subsistence users through development areas. Industry cannot deny access and all facilities need to be designed to minimize physical barriers to passage;
        b) allow subsistence harvest activities within development areas;
        c) need to address how we will manage firearm use in development areas (may or may not be issue at this time).
    - Orientation/education of security personnel as to traditional uses and access needs by subsistence users.
    - Access and firearms go hand in hand = hunting.
    - Need to be able to go where the animals are.
    - Information needs to be disseminated to community in news letters, radios, provide signs (possibly in two languages).
    - Permittees or lessees in conducting their activities cannot restrict subsistence user access.

6. Orientation Education
   - Orientation education of contractors and other industry representatives - MMS Sale 170 Stip. #2 include as part of stipulations. Proposed NPR-A stipulation, "It is the responsibility of the authorized user to assure all people brought into the planning area under its auspices adhere to these stipulations. . ." needs to be revised per MMS Sale 170 Stip. #2, Orientation Program.

7. Compensation of Subsistence Losses
   - Compensation for subsistence losses need to be provided - models: Inuvialuit (Western Canada settlement and PWS settlement in Alaska is precedent setting.

Panel Presentation to Nuiqsut Residents: The panel presented their draft recommendations to Nuiqsut residents during a second public meeting at the Kisik Community Center on the evening of August 20, 1997. Approximately 15 to 20 people attended. The following comments and concerns were expressed by Nuiqsut residents, as summarized on flipcharts:

Comments on Subsistence Advisory Panel

- Don't agree with including villages other than Nuiqsut - that's where real impacts are.
- Wainwright is in NPR-A - why not represented?
- Each community within the NPR-A should have its own advisory panel - don't include any agency representation.
- Industry representation may be helpful to resolve problems.
- If Federal Agencies are involved in panels they may not be able to arbitrate between industry and residents.
- Majority of advisory panel members should be from Nuiqsut.
- Others from Federal Agencies could participate in panel if funding came with their participation.
- Concept and effectiveness of local advisory group is diluted with others being on panel.
- How would other residents be affected if only Nuiqsut is represented on the panel?
- Already have subsistence panel: Federal North Slope Subsistence Regional Advisory Panel.
- A local panel that influences decisions that affect local residents is valuable, if local panel will have better control.
- Where is funding going to come from to support panel needs?
- Funding from impact grants should go directly to community affected - not to support panel with broad responsibilities. Use Federal funds.

Comments on access

- How can people be assured access? Along the Haul Road Pipeline firearms are not allowed. Why isn't that allowed if "reasonable access" is the criteria? A hunter needs to bring a firearm when accessing hunt areas.
- In the past, residents have been prevented access - this proposed management practice is news - and frustrating because no one is helping us to know what is right.
- Contractors have their own way of doing things, own rules and regulations. Wildlife does not have rules and regulations - no boundaries. Industry hasn't been concerned about details once documents are signed.

No comments on traditional land use sites

Comments on monitoring

- Concern for drilling for oil under an allotment: does allotment owner have a financial interest in revenues?
- Jobs are not made available to residents - promises made, but don't come through.
- Nuiqsut is most impacted - jobs need to be made available here first.
- If NPR-A is developed, require industry to hire biologists to evaluate fish and wildlife and provide information to protect them.
- Communications between agencies and NSB need to improve - misinformation is not acceptable. Want panel to find ways to improve. Arnold (NPR-A Coord.) is committed to facilitating communications and serve as liaison.

- Need this type of panel for every community facing potential oil and gas development. So important to have a Native panel - experts on land uses and impacts.

Panel Recommendations: The following recommendations are presented by the workshop panel to the BLM for consideration as management actions, lease stipulations, and/or information to lessees, and for incorporation into the Northeast NPR-A draft IAP/EIS to protect subsistence resources, uses, and users in the planning area.

1. Subsistence Advisory Panel: The BLM is encouraged to integrate public participation into decisionmaking and conflict resolution processes in relation to future potential exploration and development activities in the planning area. The following recommendation establishes a local Subsistence Advisory Panel that would facilitate community input in BLM's land use planning efforts, follow that input through the decisionmaking process, and provide feedback to the community:

BLM should establish a local Subsistence Advisory Panel to:

a) ensure responsible development in the planning area that protects subsistence resources and uses, and
b) ensure protection of subsistence resources and uses by involving local communities and agencies in development decisionmaking.

The Subsistence Advisory Panel's authority should be derived through a formal charter under provisions of the Federal Advisory Committee Act.

Responsibilities of the Subsistence Advisory Panel should include:

a) identify and address potential subsistence-use conflicts in the planning area
b) provide recommendations to BLM concerning planning, research, monitoring and assessment activities needed to facilitate responsible development and protect subsistence resources and uses in the planning area (see also Subsistence Impact Monitoring Program below);
c) inform local community and agencies about panel activities and agency actions concerning subsistence protection in the planning area;
d) maintain repository of subsistence information for local communities and agencies. Include narrative, quantitative, and spatial information. May solicit information and request analysis from cooperating agencies and other organizations;
e) ensure continuity and consistency in the collection and use of subsistence information by the advisory panel and other advisory groups;
f) hold BLM accountable for replying to all panel recommendations. The BLM should respond in writing to the Panel's recommendations with regard to what their decision is. If a recommendation is modified or not adopted, BLM should set forth the factual basis and reasons for their decision.

Membership should be composed of local residents of those communities most affected by oil exploration, development and production activities in the planning area. Nuiqsut should have five voting members, and the following communities and agencies should have one ex-officio member each: Barrow, Atqasuk, Anaktuvuk Pass, Wainwright, BLM, ADF&G, NSB, and ICAS. Subsistence Advisory Panel meetings and support staff should be centrally located in Nuiqsut.

BLM should sponsor the Subsistence Advisory Panel through provisions of FACA, and provide funding through BLM appropriations and other available funding sources. The community of Nuiqsut does not support using State impacts funds for the Panel.

2. Subsistence Impact Monitoring Program: A key element in public policy decisionmaking is having access to adequate and appropriate data on both the resources and activities being evaluated. The following recommendation establishes a program for monitoring subsistence impacts from oil-related development activities and for adjusting management strategies to minimize or avoid impacts to subsistence resources, uses, and users:

> A Subsistence Impact Monitoring Program should be developed cooperatively with input and resources from BLM, MMS, ADF&G Division of Subsistence, NSB, and the Subsistence Advisory Panel. The program should include (but is not limited to) procedures for:
>
> a) asking hunters' concerns
> b) documenting status and change of:
> - resource damage
> - resource displacement
> - hunter access to resources
> - increased competition for resources
> - contamination levels in resources
> - reduced harvests
> - increased hunter efforts, risk and cost
> - how harvest is shared
> - who is doing the harvesting (including proxy hunting)
> - relation between cash economy and subsistence economy
>
> Subsistence monitoring should also be integrated with fish and wildlife monitoring to understand the relationships between the resource populations and their uses, and land use activities that may affect the abundance or distribution of important resources.
>
> BLM should coordinate implementation of the Subsistence Impact Monitoring Program in consultation with cooperating agencies, the Subsistence Advisory Panel, and industry.
>
> Lessees should conduct monitoring of subsistence activities in cooperation with BLM, cooperating agencies, the Subsistence Advisory Panel, and local communities under the guidance of the Subsistence Impact Monitoring Program while they are in the process of oil exploration, development and production.
>
> Results of subsistence impact monitoring activities should be provided to the participating communities, the BLM and Subsistence Advisory Panel in the form of progress reports and final reports with supporting references and maps.
>
> If the Subsistence Advisory Panel identifies the existence of impacts on subsistence uses based on monitoring results, it can make recommendations to BLM regarding:
>
> a) additional mitigation measures necessary to assure continued access to subsistence sites and to areas where harvestable resources are known to occur;
> b) potential relocation of operations or redesign of production, processing and transportation facilities; and
> c) more effective mechanisms for enforcement of subsistence stipulations.

The BLM needs to address contaminants left by contractors, such as oil and gas spills. The BLM should increase monitoring of lessees, including their contractors and subcontractors, to prevent violations of lease stipulations and mitigation measures. The BLM and cooperating agencies should use local residents to conduct monitoring near their communities. Funding could be sought from a variety of sources.

3. Access: As development occurs, access to traditional areas needs to be protected. Considerable research is needed to document access routes so exploration and development activities do not interfere with subsistence access. This will involve compiling and analyzing available information as well as interviewing North Slope residents (see also Subsistence Impact Monitoring Program above).

The BLM has a legal responsibility under ANILCA Title VIII to provide reasonable access, including free passage for subsistence users through development areas, and allowing subsistence harvest activities to occur within development areas. Both access and the ability to use firearms in subsistence use areas are necessary for hunting. Industry cannot deny access, and all facilities need to be designed to minimize physical barriers to passage of both subsistence users and harvestable resources. The following recommended stipulations will minimize or avoid restrictions on access:

> Lessees should not restrict access in oil field development areas to subsistence users. Lessees should establish procedures for entrance to facilities, use of permanent gravel roads, and firearms discharge. These procedures will be coordinated through the Subsistence Advisory Panel (modified from State of Alaska Alpine Development Stipulations, Applicant's Proposed Project, Pp. 2-26, October 4, 1996).
>
> Any conflicts involving such activities as use of constructed roads by subsistence hunters, which may foreseeably impact local wildlife resources (e.g., proposed NPR-A stipulation, "Public access to goose molting areas by way of or through the use of oilfield facilities is prohibited" under Alternative E), should be presented to the Subsistence Advisory Panel for resolution.
>
> Lessees should develop and distribute information about how to hunt in development areas safely (so equipment is not damaged and people are not endangered) to the communities through newsletters, radio, and signs in both English and Inupiaq.
>
> Other permittees (e.g. overland moves, other permitted land users) should not restrict access to subsistence users while conducting their permitted activities on Federal public lands in the planning area.

4. Traditional Land Use Sites: Traditional land use sites include grave sites, archaeological sites, historical camps and trading sites, currently used camps and cabins, and hunting areas. The Subsistence Advisory Panel should evaluate and resolve issues related to traditional land use sites, especially those where development activities could restrict access to areas identified by NSB as critical to subsistence or cultural values. The following recommended stipulations will minimize or avoid impacts to traditional land use sites, and provide for continued access to these sites by local residents:

> Lessees should not restrict local residents' access to or use of traditional land use sites.
>
> Traditional land use sites should be protected from disturbance or damage.
>
> Undocumented sites should be reported to BLM and NSB Inupiat History, Language and Culture Commission when discovered. In some circumstances, the location of discovered sites may be requested to be kept confidential to preserve their original condition.
>
> BLM and NSB/IHLC should place a high priority on inventorying the Nuiqsut area for undocumented sites.

5. Cumulative Impacts: Cumulative impacts of oil exploration, development and production affect wildlife resources and people both directly (e.g., reduced populations, changes in distribution) and indirectly (e.g., capital improvement projects fudned through tax revenues). Cumulative impacts are already affecting the community of Nuiqsut. Local residents have clearly stated that they know what these impacts are. Any development in NPR-A would add to these impacts.

The Northeast NPR-A IAP/EIS should address these questions. Cumulative impact analysis is a complex and ever changing issue as the landscape of the North Slope continues to change through time. Everyone concerned should review the cumulative impact analysis in the draft IAP/EIS and provide specific comments during the public review and comment period to the BLM for consideration and incorporation into the final IAP/EIS.

The Subsistence Advisory Panel will need information on cumulative impacts, and they can suggest how to measure impacts, and evaluate the adequacy of the EIS analysis. The BLM and cooperating agencies should continue to assess cumulative impacts through stages of oil exploration, development and production.

6. Orientation Program: Local residents expressed concern about restrictions on access and use of firearms in existing oilfield development areas, despite stipulations that provide for legal access. Such conflicts may arise due to lack of understanding or appreciation by oilfield personnel of local community values, customs, and subsistence lifestyle. The following recommended stipulation establishes an orientation program to address these concerns:

> The lessee should include in any exploration or development and production plans a proposed orientation program for all personnel involved in exploration or development and production activities (including personnel of lessee's agents, contractors, and subcontractors) for review and approval by the BLM Authorized Officer. The program should be designed in sufficient detail to inform individuals working on the project of specific types of environmental, social, and cultural concerns that relate to the sale and adjacent areas. The program should address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals and provide guidance on how to avoid disturbance. This guidance will include the production and distribution of information cards on endangered and/or threatened species in the sale area. The program should be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which personnel will be operating. The orientation program should also include information concerning avoidance of conflicts with subsistence and pertinent mitigation.
>
> The program should be attended at least once a year by all personnel involved in onsite exploration or development and production activities (including personnel of lessee's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in lease activities of the lessee and its agents, contractors and subcontractors.
>
> Lessees should maintain a record of all personnel who attend the program onsite for so long as the site is active, not to exceed 5 years. This record should include the name and dates(s) of attendance of each attendee (modified from MMS Beaufort Sea Planning Area Oil and Gas Lease Sale 170, Section II, Alternatives, Stipulation No. 2).

7. Local Training and Hiring Program: Future potential development activities in the planning area could provide economic and social benefits to North Slope communities in the form of training and employment opportunities for local residents, which may offset potential impacts to social and cultural systems. Additionally, BLM and other agencies should recognize the traditional ecological knowledge and experiences of local residents and seek ways to provide opportunities for their participation in research and monitoring activities. The following recommended stipulations and management actions create local training and hiring opportunities:

> Lessees should provide training and hiring programs for local residents to work in any/all phases of oil exploration, development and production activities, including community relations personnel for Nuiqsut who could serve as a liaison between the lessee and community. Lessee should use ASRC/Kuukpik job bank (Native Employment Management Program).
>
> BLM, cooperating agencies, and industry should provide training and competitive hiring programs for local residents to participate in environmental and technical field studies (before, during, and after development).
>
> BLM, cooperating agencies, and industry should recognize traditional ecological knowledge and hire local residents at competitive rates for their knowledge and experience.

8. Subsistence Loss Compensation: Subsistence resources and access are priceless to the residents of the North Slope and should be maintained to allow for the continuation of traditional subsistence activities in the planning area. Impacts to subsistence are both collective and individual in nature and can affect cultural traditions with social and economic ramifications. In order to provide "insurance" for those instances where damage does occur from oil exploration, development, and production activities despite sound management and protective measures, a comprehensive compensation program should be investigated and developed by BLM. Existing models are available from the Inuvialuit Final Agreement of the Western Arctic Land Claim (Canada, May 5, 1987) and Prince William Sound oil- spill settlement in Alaska. The need for comprehensive compensation recourses and procedures was also addressed by the Inuit Circumpolar Conference in their report, *Principles and Elements on Renewable Resources and Inuit Subsistence Rights* (ca. 1992). However, it is important to clarify that this recommendation is not meant to convey that subsistence resources and access can simply be "purchased" as a cost of doing business on the North Slope. Rather, the objectives of the subsistence loss compensation program are (a) to create an incentive to prevent damage to wildlife and fisheries resources and their habitats and to avoid disruption of subsistence harvesting activities by Nuiqsut, Barrow, Atqasuk, and Wainwright resulting from oil exploration, development, and production activities in the planning area; and (b) *if* damage does occur, to restore wildlife and fisheries resources and their habitats as far as is practicable to their original state and to compensate hunters, trappers, and fishermen for the loss of their subsistence-harvesting opportunities. The following recommended stipulation outlines a process for compensation of subsistence losses:

> Lessee should be required to prove financial responsibility before being authorized to undertake any activity on a lease within the planning area. The lessee should provide for and ensure financial responsibility with respect to the obligations and undertakings provided in this stipulation in the form of a letter of credit, guarantee or indemnity bond or any other form satisfactory to the BLM and the Subsistence Advisory Panel.
>
> Where it is established by BLM and the Subsistence Advisory Panel that actual subsistence wildlife or fisheries harvest loss or future loss was caused by development, the liability of the lessee should be absolute and liable without proof of fault or negligence for compensation to the injured party(ies) and for the cost of mitigative and remedial measures. Factors for determining the nature and extent of damages should include degree of injury to harvested resources and related habitats, importance of affected resources to Inupiat, dislocation of wildlife resources, duration of recovery period for resources affected, and future need for hunters to travel greater distances in search of game.
>
> In those circumstances in which the BLM and Panel disagree on whether damage has occurred or what the liability should be, they are encouraged to initiate an alternative dispute resolution process mediated by a neutral third party to reach consensus. BLM has the ultimate decisionmaking authority and is responsible for ensuring compliance with lease stipulations.

9. Conflict Avoidance Agreements: Oil exploration, development, and production operations should be conducted in a manner that prevents unreasonable conflicts between the oil and gas industry and subsistence activities. One mechanism for assuring that such operations are compatible with subsistence hunting and fishing is a conflict avoidance agreement between the lessee and the affected community(ies). The following recommended stipulation provides for proactive consultation and conflict avoidance:

> Prior to submitting an exploration plan or development and production plan, the lessee should consult with the potentially affected subsistence community(ies) (e.g., Nuiqsut, Barrow, Atqasuk), the NSB, and the NPR-A Subsistence Advisory Panel to discuss potential conflicts with the siting, timing, and methods of proposed operations and safeguards or mitigating measures which could be implemented by the operator to prevent unreasonable conflicts. Through this consultation, the lessee should make every reasonable effort, including such mechanisms as a conflict avoidance agreement, to assure that exploration, development, and production activities are compatible with subsistence hunting and fishing activities and will not result in unreasonable interference with subsistence harvests in the planning area.
>
> A discussion of resolutions reached during this consultation process and plans for continued consultation should be included in the exploration plan or development and production plan. In particular, the lessee should show in the plan how its activities, in combination with other activities in the area, will be scheduled and located to prevent unreasonable conflicts with

629

subsistence activities. Lessees should also include a discussion of multiple or simultaneous operations, such as ice road construction and seismic activities, that can be expected to occur during operations in order to more accurately assess the potential for cumulative affects. Communities, individuals, and other entities who were involved in the consultation should be identified in the plan. The BLM should send a copy of the exploration or development and production plan to the potentially affected community(ies), the NSB, and the NPR-A Subsistence Advisory Panel at the time they are submitted to BLM to allow concurrent review and comment as part of the plan approval process.

In the event that no conflict avoidance agreement is reached between the parties, the lessee, affected community(ies), NSB and/or NPR-A Subsistence Advisory Panel may request that the BLM initiate an alternative dispute resolution process mediated by a neutral third party to resolve the issues before making a final determination on the adequacy of the measures taken to prevent unreasonable conflicts with subsistence harvests.

The lessee should notify the BLM Authorized Officer of all concerns expressed by subsistence hunters during operations and of the steps taken to address such concerns. Lease-related activities will be restricted when the BLM Authorized Officer determines it is necessary to prevent unreasonable conflicts with local subsistence activities.

In enforcing this stipulation, the BLM will work with other agencies and the public to assure that potential conflicts are identified and protective measures are implemented to avoid these conflicts (modified from MMS Beaufort Sea Planning area Oil and Gas Lease Sale 170, Section II, Alternatives, Stipulation 5).

10. Maintaining Healthy Wildlife Populations: The above recommendations provide protective measures for subsistence users. But it is important to note that one of the most important elements in protecting peoples' ability to subsistence hunt and fish is maintaining healthy wildlife populations that are available in sufficient numbers in both time and space. For example, the Teshekpuk Lake Caribou Herd is recognized as one of the most important subsistence resources for many of the villages on the North Slope. These caribou are harvested both within and outside of the planning area. If activities within the calving grounds, insect relief areas, or migration pathways detrimentally affect productivity or change movement patterns of the herd, it could impact subsistence hunters across the North Slope. Protective measures must be implemented to minimize impacts of oil exploration, development and production on critical fish and wildlife habitats; which will subsequently benefit both the wildlife populations and the subsistence users who rely on them.

References

BLM. 1997 (in prep.). Teshekpuk Lake Waterfowl/Caribou Impact Analysis Workshop Proceedings. BLM, Northern District, Fairbanks, AK.

George, J. C. 1997. Letter to Dee R. Ritchie, District Manager, BLM, Northern District, Fairbanks, AK. April 17, 1997.

MMS. 1997. NPR-A Symposium Proceedings. OCS Study MMS 97-0013. Anchorage, AK.

Subsistence Impact Analysis Workshop
Participant List

Mark Ahmakak
P. O. Box 42
Nuiqsut, AK 99789
Ph: (907) 480-6223
Fax: (907) 480-6222

Michael Baffrey
Minerals Management Service
949 E. 36th Avenue
Anchorage, AK 99508-4363
Ph: (907) 271-6677
Fax: (907) 271-6507
E-mail: michael.baffrey@mms.gov

Arnold Brower, Jr.
North Slope Borough
Office of the Mayor
P. O. Box 69
Barrow, AK 99723
Ph: (907) 852-0488
Fax: (907) 852-0337

Harry Brower, Jr.
North Slope Borough
Department of Wildlife Management
P. O. Box 69
Barrow, AK 99723
Ph: (907) 852-0350
Fax: (907) 852-0351

Geoff Carroll
Alaska Department of Fish and Game
Division of Wildlife Conservation
P. O. Box 1284
Barrow, AK 99723
Ph: (907) 852-3463
Fax: (907) 852-3465
E-mail: gcarroll@fishgame.state.ak.us

Jon Dunham
North Slope Borough
Department of Planning
P. O. Box 69
Barrow, AK 99723
Ph: (907) 852-0440 ext. 226
Fax: (907) 852-5991
E-mail: jdunham@co.north-slope.ak.us

Peggy Fox (Facilitator)
BLM Alaska State Office
222 W. 7th Avenue
Anchorage, AK 99513
Ph: (907) 271-3346
Fax: (907) 271-5479
E-mail: p1fox@ak.blm.gov

John "Craig" George
North Slope Borough
Department of Wildlife Management
P. O. Box 69
Barrow, AK 99723
Ph: (907) 852-2611 ext. 350
Fax: (907) 852-0351
E-mail: cgeorge@co.north-slope.ak.us

Dorothy Hopson (Panel Alternate)
c/o City of Anaktuvuk Pass
P. O. Box 21030
Anaktuvuk Pass, AK 99721
Ph: (907) 661-3612
Fax: (907) 661-3613

James Kignak, Sr.
P. O. Box 23
Atqasuk, AK 99791
Ph: (907) 663-6515
Fax: (907) 663-6324

Anne Morkill (Coordinator)
BLM Northern District Office
1150 University Avenue
Fairbanks, AK 99709
Ph: (907) 474-2340
Fax: (907) 474-2282
E-mail: amorkill@ak.blm.gov

Johanna Munson (Coordinator)
State of Alaska Representative
c/o BLM Alaska State Office
222 W. 7th Avenue
Anchorage, AK 99513
Ph: (907) 271-3859
Fax: (907) 271-5479
E-mail: jmunson@ak.blm.gov

Sverre Pedersen
Alaska Department of Fish and Game
Division of Subsistence
1300 College Road
Fairbanks, AK 99701
Ph: (907) 459-7318
Fax: (907) 479-5699
E-mail: spedersen@fishgame.state.ak.us

Thomas Rulland
P. O. Box 21033
Anaktuvuk Pass, AK 99721
Ph: (907) 661-3612
Fax: (907) 661-3613

Paul Stang
Minerals Management Service
949 E. 36th Avenue
Anchorage, AK 99508-4363
Ph: (907) 271-6570
Fax: (907) 271-6805
E-mail: paul.stang@mms.gov

Gordon Upicksoun
c/o Don Long
Inupiat Community of the Arctic Slope
P. O. Box 934
Barrow, AK 99723
Ph: (907) 852-4227
Fax: (907) 852-4246

Dave Yokel
BLM Northern District Office
1150 University Avenue
Fairbanks, AK 99709
Ph: (907) 474-2314
Fax: (907) 474-2282
E-mail: dyokel@ak.blm.gov

APPENDIX G

Wild and Scenic Rivers Management Objectives and Standards and Assessment Process

MANAGEMENT OBJECTIVES AND STANDARDS
FOR DESIGNATED
WILD AND SCENIC RIVERS

I. Wild Rivers

A. Objective: The management of wild river areas should give primary emphasis to protecting the values that make it outstandingly remarkable while providing river-related outdoor recreation opportunities in a primitive setting.

B. Management Standards: Allowable management practices might include construction of minor structures for such purposes as: improvement of fish and game habitat; grazing protection from fire, insects, or disease; and rehabilitation or stabilization of damaged resources, provided the area will remain natural appearing and the practices or structures will harmonize with the environment. Developments such as trail bridges, occasional fencing, natural-appearing water diversions, ditches, flow measurement or other water management devices, and similar facilities may be permitted, if they are unobtrusive and do not have a significant direct and adverse effect on the natural character of the river area. The following program management standards apply.

1. Forestry Practices: Cutting of trees will not be permitted except when needed in association with a primitive recreation experience (such as clearing for trails and for visitor safety or to protect the environment (such as control of fire). Timber outside the boundary, but within the visual corridors should, where feasible, be managed and harvested in a manner to provide special emphasis to visual quality.

2. Water Quality: Water quality will be maintained or improved to meet Federal criteria or federally approved State standards. (River management plans shall prescribe a process for monitoring water quality on a continuing basis).

3. Hydroelectric Power and Water Resource Development: No development of hydroelectric power facilities would be permitted. No new flood-control dams, levees, or other works allowed in the channel or river corridor. All water-supply dams and major diversions are prohibited. The natural appearance and essentially primitive character of the river area must be maintained. Federal agency groundwater development for range, wildlife, recreation or administrative facilities may be permitted, if there are no adverse affects on outstandingly remarkable river related values.

4. Mining: New mining claims and mineral leases are prohibited within ¼ mile of the river. Valid existing claims would not be abrogated and, subject to existing regulations (e.g., 43 CFR 3809) and any future regulations that the Secretary of the Interior may prescribe to protect the rivers included in the National System, existing mining activity would be allowed to continue. All mineral activity on federally administered land must be conducted in a manner that minimizes surface disturbance, water sedimentation, pollution, and visual impairment. Reasonable mining claim and mineral lease access will be permitted. Mining claims, subject to valid existing rights, within the wild river area boundary can be patented only as to the mineral estate and not the surface estate (subject to proof of discovery prior to the effective date of designation).

5. **Road and Trail Construction:** No construction of new roads, trails, or other provisions for overland motorized travel would be permitted within the river corridor. A few inconspicuous roads or unobtrusive trail bridges leading to the boundary of the river area may be permitted.

6. **Recreation Facilities:** Major public-use areas, such as campgrounds, interpretive centers, or administrative headquarters are located outside wild river areas. Simple comfort and convenience facilities such as toilets, tables, fireplaces, shelters, and refuse containers may be provided as necessary within the river area. These should harmonize with the surroundings. Unobtrusive hiking and horseback riding trail bridges could be allowed on tributaries but would not normally cross the designed river.

7. **Public Use and Access:** Recreation use including, but not limited to, hiking, fishing, and boating is encouraged in wild river areas to the extent consistent with the protection of the river environment. Public use and access may be regulated and distributed where necessary to protect and enhance wild river values.

8. **Rights-of-Way:** New transmission lines, natural gas lines, water lines, etc., are discouraged unless specifically prohibited outright by other plans, orders or laws. Where no reasonable alternative exists, additional or new facilities should be restricted to existing rights-of-way. Where new rights-of-way are unavoidable, locations and construction techniques will be selected to minimized adverse effects on wild river area related values and fully evaluated during the site selection process.

9. **Motorized Travel:** Motorized travel on land or water could be permitted but it is generally not compatible with this river classification. Normally, motorized use will be prohibited in a wild river area. Prescriptions for management of motorized use may allow for search and rescue and other emergency situations.

II. Scenic Rivers

A. **Management Objective:** Management of scenic river areas should maintain and provide outdoor recreation opportunities in a near-natural setting. The basic distinctions between a "wild" and a "scenic" river area are the degree of development, types of land use, and road accessibility. In general, a wide range of agricultural, water management, silvicultural, and other practices could be compatible with scenic river values, providing such practices are carried on in such a way that there is no substantial adverse effect on the river and its immediate environment.

B. **Management Standards:** The same considerations set forth for wild river areas should be considered, except that motorized vehicle use may, in some cases, be appropriate and that development of larger scale public-use facilities within the river area, such as moderate-sized campgrounds, interpretive centers, or administrative headquarters would be compatible if such facilities were screened from the river. The following program management standards apply.

1. **Forest Practices:** Silvicultural practices including timber harvesting could be allowed provided that such practices are carried on in such a way that there is no substantial adverse effect on the river and its immediate environment. The river area should be maintained in its near-natural condition. Timber outside the boundary, but within the visual seen area, should be managed and harvested in a manner which provides special emphasis on visual quality. Preferably, reestablishment of tree cover would be through natural revegetation. Cutting of dead and down materials for fuelwood should be limited. Where necessary, restrictions on use of wood for fuel may be prescribed.

2. **Water Quality:** Water quality will be maintained or improved to meet Federal criteria or federally approved State standards. (River management plans shall prescribe a process for monitoring water quality on continuing basis.)

3. **Hydroelectric Power and Water Resource Development:** No development of hydroelectric power facilities would be permitted. Flood-control dams and levees would be prohibited. All water supply dams and major diversions are prohibited. Maintenance of existing facilities and construction of some new structures would be permitted provided that the area remains natural in appearance and the practices or structures harmonize with the surrounding environment.

4. **Mining:** Subject to existing regulations (e.g., 43 CFR 3809) and any future regulations that the Secretary of the Interior may prescribe to protect the values of rivers included in the National System, new mining claims are allowed and mineral leases can be allowed. All mineral activity on federally administered land must be conducted in a manner that minimizes surface disturbance, water sedimentation and pollution, and visual impairment. Reasonable mining claim and mineral lease access will be permitted. Mining claims within the scenic river area boundary can be patented only as to the mineral estate and not the surface estate.

5. **Road and Trail Construction:** Roads or trails may occasionally bridge the river area and short stretches of conspicuous or long stretches of inconspicuous and well-screened roads could be allowed. Maintenance of existing roads and trails, and any new roads or trails, will be based on the type of use for which the roads/trails are constructed and the type of use that will occur in the river area.

6. **Agricultural Practices and Livestock Grazing:** In comparison to wild river areas, a wider range of agricultural and livestock grazing uses is permitted to the extent currently practiced. Row crops are not considered as an intrusion of the "largely primitive" nature of scenic corridors as long as there is not a substantial adverse effect on the natural-like appearance of the river area.

7. **Recreation Facilities:** Larger scale public-use facilities, such as moderate-sized campgrounds, interpretive centers, or administrative headquarters are allowed if such facilities are screened from the river.

8. **Public Use and Access:** Recreation use including, but not limited to: hiking, fishing, hunting, and boating is encouraged in scenic river areas to the extent consistent

with the protection of the river environment. Public use and access may be regulated and distributed where necessary to protect and enhance scenic river values.

9. **Rights-of-Way:** New transmission lines, natural gas lines, etc., are discouraged unless specifically prohibited outright by other plans, orders or laws. Where no reasonable alternative exists, additional or new facilities should be restricted to existing rights-of-way. Where new rights-of-way are unavoidable, locations and construction techniques will be selected to minimize adverse effects on scenic river area related values and fully evaluated during the site selection process.

10. **Motorized Travel:** Motorized travel on land or water may be permitted, prohibited, or restricted to protect river values. Prescriptions for management of motorized use may allow for search and rescue and other emergency situations.

III. Recreational River Areas

A. **Management Objective:** Management of recreational river areas should give primary emphasis to protecting the values which make it outstandingly remarkable while providing river-related outdoor recreation opportunities in a recreational setting. Management of recreational river areas should maintain and provide outdoor recreation opportunities. The basic distinctions between a "scenic" and a "recreational" river area are the degree of access, extent of shoreline development, historical impoundment or diversion, and types of land use. In general, a wide range of agricultural, water management, silvicultural, and other practices are compatible with recreational river values, providing such practices are carried on in such a way that there is no substantial adverse effect on the river and its immediate environment.

B. **Management Standards:** Recreation facilities may be established in proximity to the river, although recreational river classification does not require extensive recreational development. Recreational facilities may still be kept to a minimum, with visitor services provided outside the river area. Future construction of impoundments, diversions, straightening, riprapping, and other modification of the waterway or adjacent lands would not be permitted except in instances where such developments would not have a direct and adverse effect on the river and its immediate environment. The following program management standards apply.

1. **Forestry Practices:** Forestry practices including timber harvesting would be allowed under standard restrictions to avoid adverse effects on the river environment and its associated values.

2. **Water Quality:** Water quality will be maintained or improved to meet Federal criteria or federally approved State standards. (River management plans shall prescribe a process for monitoring water quality on a continuing basis.)

3. **Hydroelectric Power and Water Resource Development:** No development of hydroelectric power facilities would be permitted. Existing low dams, diversion works, rip rap, and other minor structures may be maintained provided the waterway remains

generally natural in appearance. New structures may be allowed provided that the area remains generally natural in appearance and the structures harmonize with the surrounding environment. 4. Mining: Subject to existing regulations (e.g., 43 CFR 3809) and any future regulations that the Secretary of the Interior may prescribe to protect values of rivers included in the National System, new mining claims are allowed and existing operations are allowed to continue. All mineral activity on federally administered land must be conducted in a manner that minimizes surface disturbance, water sedimentation and pollution, and visual impairment. Reasonable mining claim and mineral lease access will be permitted. Mining claims within the recreational river area boundary can be patented only as to the mineral estate and not the surface estate.

5. **Road and Trail Construction:** Existing parallel roads can be maintained on one or both river banks. There can be several bridge crossings and numerous river access points. Roads, trails, and visitor areas must conform to construction and maintenance standards and be free of recognized hazards.

6. **Agricultural Practices and Livestock Grazing:** In comparison to scenic river areas, lands may be managed for a full range of agriculture and livestock grazing uses, consistent with current practices.

7. **Recreation Facilities:** Interpretive centers, administrative headquarters, campgrounds, and picnic areas may be established in proximity to the river. However, recreational classification does not require extensive recreation development.

8. **Public Use and Access:** Recreation use including, but not limited to, hiking, fishing, hunting, and boating is encouraged in recreational river areas to the extent consistent with the protection of the river environment. Public use and access may be regulated and distributed where necessary to protect and enhance recreational river values. Any new structures must meet established safety and health standards or in their absence be free of any recognized hazard.

9. **Rights-of-Way:** New transmission lines, natural gas lines, water lines, etc., are discouraged unless specifically prohibited outright by other plans, orders and laws. Where no reasonable alternative exists, additional or new facilities should be restricted to existing rights-of-way. Where new rights-of-way are unavoidable, locations and construction techniques will be selected to minimize adverse effects on recreational river area related values and fully evaluated during the site selection process.

10. **Motorized Travel:** Motorized travel on land will generally be permitted, on existing roads. Controls will usually be similar to that of surrounding lands. Motorized travel on water will be in accordance with existing regulations or restrictions.

IV. Management Objectives Common to Wild, Scenic, and Recreation Rivers

A. **Fire Protection and Suppression:** Management and suppression of fires within a designated river area will be carried out in a manner compatible with contiguous Federal lands. On wildfires, suppression methods will be used that minimize long term impacts on the river and river area. Presuppression and prevention activities will be conducted in a manner which reflects management objectives for the specific river segment. Prescribed fire may be used to maintain or restore ecological condition or meet objectives of the river plan.

B. Insects, Diseases, and Noxious Weeds: The control of forest and rangeland pests, diseases, and noxious weed infestations will be carried out in a manner compatible with the intent of the Act and management objectives of contiguous Federal lands.

C. Cultural Resources: Historic prehistoric resource sites will be identified, evaluated and protected in a manner compatible with the management objectives of the river and in accordance with applicable regulations and policies. Where appropriate, historic or prehistoric sites will be stabilized, enhanced, and interpreted.

D. Fish and Wildlife Habitat Improvement: The construction and maintenance of minor structures for the protection, conservation, rehabilitation or enhancement of fish and wildlife habitat are acceptable provided they do not affect the free flowing characteristics of the river, are compatible with the classification, that the area remains natural in appearance and the practices or structures harmonize with the surrounding environment.

E. Water Rights: In the process of evaluating river segments, authorizing officials are held to established principles of law with respect to water rights. Under provisions of Section 13 of the Act, as well as other statutes, river studies shall not interfere (except for licenses under Sec. 7(b) of the Act, pertaining to Sec. 5(a) WSR river studies) with existing rights, including the right of access, with respect to the beds of navigable streams, tributaries, or river segments. In addition, under the Federal Land Policy and Management Act and Federal Power Act, the BLM has permitting and conditioning authorities for any proposed projects which might be incompatible with any river or other identified resource values.

ASSESSMENT PROCESS FOR WILD AND SCENIC RIVERS

The review of wild and scenic values within the Northeast NPR-A Planning Area is being completed using a three-step planning process.

Step 1—Identification. The Wild and Scenic Rivers Act (WSRA) defines a river as "a flowing body of water or estuary or a section, portion, or tributary thereof, including rivers, stream, runs, kills, rills, and small lakes." Ordinarily, if a river or river segment is identified in an official publication or list of another agency or recognized river support organization, and if BLM-administered lands are located within a quarter of a mile of the identified river's ordinary high-water mark, a case can be made to select it for consideration. Additionally, criteria used in the 1978 105(c) studies supplemented BLM's identification process. The BLM identified 18 rivers in the planning area for evaluation in this IAP/EIS.

Step 2—Eligibility Determination. Each identified river segment must be evaluated to determine whether or not it is eligible for inclusion in the Wild and Scenic River System (WSRS). To be eligible, a river segment must be "free-flowing" and must possess at least one "outstandingly remarkable value."

1. ***Free Flowing*:** Free flowing is defined by Section 16(b) of the WSRA as "existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway."

2. ***Outstandingly Remarkable Values*:** Section 1(b) of the WSRA requires that for a river segment to be eligible for inclusion in the WSRS, it must possess one or more of the following outstandingly remarkable values: scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values.

Based on these criteria, the Colville River has been determined to be eligible for inclusion in the WSRS.

Step 3—Suitability Analysis. Based on the public comments received during the Draft IAP/EIS comment period, BLM will further evaluate the Colville River to determine whether it would be suitable for inclusion in the WSRS. The factors considered in a suitability determination are based on Section 4(a) of the WSRA and are elaborated on in Bureau Manual 8351A. These factors are:

1. Characteristics that do or do not make the area worthy of addition to the WSRS;

2. Land ownership and associated or incompatible uses. The Bureau Manual states that: "In situations where there is limited public lands administered by the BLM. . .it may be difficult to ensure. . .outstandingly remarkable values could be properly maintained. . .. Accordingly, for those situations where the BLM is unable to protect or maintain any identified outstandingly remarkable values, or through other mechanisms (existing or potential), river segments may be determined suitable only if the entity with land use planning responsibility supports the finding and commits to assisting the BLM in protecting the identified river values." The Manual goes on

640

to state that: ". . .there might be existing or future opportunities for the BLM to acquire river shoreline or where landowners are willing to donate, exchange, transfer, assign, sell, or sign an easement";

3. Reasonably foreseeable potential uses of the land and related waters that would be enhanced, foreclosed, or curtailed in the area were included in the WSRS, and the values that could be foreclosed or diminished if the area is not protected as part of the WSRS;

4. Interest in designation or nondesignation, including the extent to which the administration of the river, including the costs thereof, may be shared by State, local, or other agencies or individuals;

5. Estimated costs of acquiring lands, interests in lands, and administering the area if it is added to the WSRS; and

6. The ability of the BLM to manage and/or protect the river area as a wild and scenic river, or other mechanisms (existing and potential) to protect identified values other than wild and scenic river designation.

A finding of nonsuitability may be based on one or a combination of these factors.

Boundary Identification: The final boundary determination generally is completed in the river management plan, which must be completed within 3 years of designation. A corridor boundary area extends the length of the identified river segment and includes the river area, its immediate environment, and lands within an average of half a mile (no more than 640 acres per river mile) of ordinary high water on each bank.

APPENDIX H

Visual Resource Management

BLANK PAGE

VISUAL RESOURCE MANAGEMENT

Definition: The Visual Resource Management (VRM) classes are used to define minimum management objectives. Each class describes a different degree of modification allowed in the basic elements of the landscape and still retain the character of the landscape.

The VRM classes are defined by three factors: (1) scenic quality, (2) visual sensitivity, and (3) distance zones. The classes are then used as the basis for the following objectives: (1) enhancement, (2) rehabilitation, and (3) protection. Finally, these objectives become program outlines for resource planning and project design.

Resource Management Classes:

Class I–This class provides primarily for natural ecological changes and does not preclude very limited management activity. Any contrast created within the characteristic landscape must not attract attention. This class is applied to wilderness areas, wild and scenic rivers, and other similar situations.

Class II–Changes in any of the basic elements (form, line, color, texture) caused by a management activity should not be evident in the characteristic landscape. The contrast may be seen but must not attract attention.

Class III–Contrasts to the basic elements (form, line, color, texture) caused by a management activity may be evident and begin to attract attention but should remain subordinate to the existing landscape.

Class IV–Contrast may attract attention and be a dominant feature of the landscape in terms of scale but should repeat the form, line, color, and texture of the characteristic landscape.

Class V–Change is needed or change may add acceptable visual variety to an area. This class applies to areas where the natural character has been disturbed to a point where rehabilitation is needed to bring it back into character with the surrounding landscape. This class would apply to areas identified in the scenic evaluation where the quality of the class has been reduced because of unacceptable cultural modification.

Design Techniques for Mitigating Visual Impacts:

A. Landform/Waterbody

1. Reduce the size of cut and fill slopes. Consider:

    (a) Relocating to an area with less slope.
    (b) Changing road width, grade, etc.
    (c) Changing alignment to follow existing grades.
    (d) Prohibiting dumping of excess material on downhill slopes.

2. Reduce earthwork contrasts. Consider:

    (a) Rounding and/or warping slopes.
    (b) Retaining rocks, trees, drainages, etc.
    (c) Toning down freshly broken rock faces with asphalt-emulsion spray or with gray paint.
    (d) Adding mulch, hydromulch, or topsoil.
    (e) Shaping cuts and fills to appear as natural forms.
    (f) Cutting rock areas so forms are irregular.
    (g) Designing to take advantage of natural screens (i.e., vegetation, landforms).

(h) Grass seeding of cuts and fills.

3. Maintain the integrity of topographic units. Consider:

   (a) Locating projects away from prominent topographic features.
   (b) Designing projects to blend with topographic forms in shape and placement.

B. *Vegetation*

1. Retain existing vegetation. Consider:

   (a) Using retaining walls on fill slopes.
   (b) Reducing surface disturbance.
   (c) Protecting roots from damage during excavations.

2. Enhance revegetation. Consider:

   (a) Mulching cleared areas.
   (b) Controlling planting times.
   (c) Furrowing slopes.
   (d) Planting holes on cut/fill slopes.
   (e) Choosing native plant species.
   (f) Stockpiling and reusing topsoil.
   (g) Fertilizing, mulching, and watering vegetation.

3. Minimize impact on existing vegetation. Consider:

   (a) Partial cut instead of clearcut.
   (b) Using irregular clearing shapes.
   (c) Feathering/thinning edges.
   (d) Disposing of all slash.
   (e) Controlling construction access.
   (f) Utilizing existing roads.
   (g) Limiting work within construction area.
   (h) Selecting type of equipment to be used.
   (i) Minimizing clearing size (i.e., strip only where necessary).
   (j) Grass seeding of cleared areas.

4. Maintain the integrity of vegetative units. Consider:

   (a) Utilizing the edge effect for structure placement along natural vegetative breaks.

C. *Structures*

1. Minimize the number of visual structures.

2. Minimize structure contrast. Consider:

   (a) Using earthtone paints and stains.
   (b) Using cor-ten steel (self-weathering).
   (c) Treating wood for self-weathering.
   (d) Using natural stone surfaces.
   (e) Burying all or part of the structure.
   (f) Selecting paint finishes with low levels of reflectivity (i.e., flat or semigloss).

3. Redesign structures that do not blend/fit in. Consider:

   - (a) Using rustic designs and native building materials.
   - (b) Using natural-appearing forms t complement landscape character (use special designs only as a last resort).
   - (c) Relocating structure.

4. Minimize impact of utility crossing. Consider:

   - (a) Making crossings at right angles.
   - (b) Setting back structures at a maximum distance from the crossing.
   - (c) Leaving vegetation along the roadside.
   - (d) Minimizing view time.
   - (e) Utilizing natural screening.
   - (f) Relocating structure.

5. Recognize the value and limitations of color. Consider:

   - (a) That color (hue) is most effective within 1,000 feet. Beyond that point, color becomes more difficult to distinguish and tone or value determines visibility and resulting visual contrast.
   - (b) That using color has limited effectiveness in the structures that are silhouetted against the sky.
   - (c) Painting structures somewhat darker than the adjacent landscape to compensate for the effects of shade and shadow.
   - (d) Selecting color to blend with the land and not the sky.

APPENDIX I

The Inupiat People's History and Future with regard to the National Petroleum Reserve-Alaska (NPR-A) A 1997 Perspective from the North Slope Borough

The Inupiat People's History and Future
with regard to the National Petroleum Reserve-Alaska (NPR-A)
A 1997 Perspective from the North Slope Borough

During this period of renewed national interest in the area, it is important to consider the perspective of the Inupiat Eskimo, the people who live within the boundaries of the 23.7 million acre National Petroleum Reserve-Alaska (NPR-A).

The North Slope Borough, the local home rule body which governs the area in which NPR-A is located, appreciates the opportunity to speak on behalf of its citizens in this IAP/DEIS.

The Borough government represents the 6,000 residents of America's northern most region, who are predominately Inupiat Eskimo and who unquestionably will be impacted most immediately by management decisions and the various activities discussed in this draft EIS.

Federal agencies engaged in preparing the DEIS address significant issues which are related to NPR-A's lands, to the Inupiat people's use of these lands and the fish and wildlife, to our people's subsistence way of life and to their future. Similarly, the future of our subsistence uses and relationships between the land, our culture and tradition and our people have implications for the NPR-A leasing and land management policy which the DEIS is addressing.

The NSB offers these facts and views to other citizens interested in NPR-A because, like other Americans, the Inupiat are concerned about things that happen in our home and "neighborhood", the NPR-A.

Reviewing this document will provide the public and responsible decision-makers a local perspective on the special concerns of the North Slope residents who want to continue our life there forever. Decisions about management, recreation and oil leases must be based on full knowledge of the Eskimo people's historic and current uses and interests, with an eye toward the future and avoiding needless conflicts.

This Statement of Additional Views is intended to give voice to the Inupiat Eskimo people who live in Arctic Alaska. This is their statement, organized simply as follows:

1. Inupiat history and current use in the NPR-A area.
2. Recent history of land selections in the U.S. (Alaska) Arctic
3. Conclusion and essential elements of a NSB-preferred final EIS alternative

1. Inupiat history and current use in the NPR-A area.

The Inupiat people have lived and subsisted in the Arctic for centuries and continue to do so today, and plan to do so for the foreseeable future. This the Inupiat people want to be known, first and foremost.

The Inupiat people's continuous and unbroken use of the entire 23.7 million acre NPR-A and its 4.6 million acre northeastern study area predates by centuries any occupation or claim by others and any land ownership designation in the region.

The Inupiat Eskimo people have roamed the vast Alaska Arctic for thousands of years, catching fish and game, settling and camping according to the seasons and the abundance of wildlife. Much of the activity took place along the coast and rivers, but inland travel was common, with rivers serving as "highways" when overland or ocean travel was not preferred. Seasonal camp shelters, rest areas and supply caches, ice cellars for storage and small dwellings are spread across the Arctic still to support safe long-distance travel in the extreme Arctic conditions.

Traditional land use sites and primitive infrastructure were, and still are, shared by extended families, hunting partners, whaling crew members and other friends and occasional strangers. The responsibility for these sites continues to be passed on to successive generations as younger people are taught by their elders the detailed patterns of the area's resources, Arctic survival lessons and most importantly, the Inupiat way of life, *Inuuniagniq* - - subsistence.

Today, in the remote Arctic, "bush villages" have evolved, with airports the main transportation facility. On the North Slope, some settlements still have "honey bucket" waste systems with limited potable water. Other villages are more modern than others with electricity, safe drinking water and even some flush toilets in the more intensely-settled communities. Barrow is the largest village, serving as the regional service center for the whole North Slope, containing half the population and the North Slope Borough government headquarters.

Still, in 1997, four of the eight villages in the Borough, namely Nuiqsut, Barrow, Wainwright and Atqasuk, remain surrounded by NPR-A boundaries. The other four other established villages are Point Hope, Point Lay, Kaktovik (Barter Island) and Anaktuvuk Pass. Point Lay and Anaktuvuk Pass have subsistence relationships within the NPR-A area, and hunt many of the same migratory species which roam the vast North Slope.

Wherever the animals and fish go, that is where you will find the Inupiat living to hunt and fish. To the Inupiat, NPR-A and other federal boundaries seem artificial, but the people have learned to co-exist with them.

2. Recent history of land selections in the U.S. (Alaska) Arctic

A review of the lands history involving the Arctic shows how North Slope lands were progressively withdrawn from selection by the NSB government and by Inupiat people and their village and regional corporations, even though each entity consistently expressed its desire to select lands within the NPR-A (and other federal Arctic areas) under municipal or native entitlement.

Much of this history was marked by federal actions such as a new administrative designation of two "Special Areas" within the NPR-A for example, without attending first to the rights of the Inupiat people who live there.

Lands available for Inupiat selection were severely limited by prior state and federal government selection, without regard to Inupiat use of or their aboriginal title to the land. The remaining land in many cases was not useful for historic or future needs.

In summary:

1923 An Executive Order #3234 by President Harding designates 23.7 million acres of the western Arctic as the Naval Petroleum Reserve No. 4 – or PET 4.

1959 Alaska accepts statehood with a 102 million acre land entitlement which includes much of the remaining central Arctic where the giant Prudhoe Bay oilfield is discovered ten years later, also removing it from Inupiat selection.

1960 8.9 million acres of the eastern Arctic are withdrawn for the Arctic National Wildlife Range, adjacent to the Inupiat community of Kaktovik.

1971 The Alaska Native Claims Settlement Act (ANCSA) created 13 regional corporations and allowed for a total native lands settlement of 44 million acres, but only in areas not already federally-designated or in some cases, state-selected.

Arctic Slope Regional Corporation (ASRC), the North Slope regional corporation, was denied its subsurface selection rights within NPR-A as a result, with villages given limited surface selection in the petroleum reserve.

1976 The Naval Petroleum Reserves Production Act (NPRPA) re-names PET 4 the National Petroleum Reserve-Alaska (NPR-A) and puts it under the Department of Interior jurisdiction.

1980 The Alaska National Interest Lands Conservation Act (ANILCA) expands and creates refuges, new parks and preserves which further divide the Inupiat traditional homeland into restrictive conservation units, including designated Wilderness.

1997 Secretary Babbitt visits the North Slope people, including a visit to a subsistence hunting and fishing camp and promises the Inupiat residents he will "not perpetuate 500 years of separating people from the land."

649

3. Conclusion and essential elements of a NSB-preferred final EIS alternative

The Inupiat people heard and believed Secretary Babbitt as he spoke.

During this latest renewal of national interest in NPR-A, the Inupiat people believe that the federal government should address and resolve outstanding land issues with the Native people who live there. This should happen before, or concurrent with, oil and gas leasing, or any other special designations in the NPR-A.

The North Slope Borough, ASRC and the village and tribal governments of the North Slope have all recommended land settlement proposals, exchanges and other options to give the Inupiat legally-recognized access and title to their traditional land use sites. This issue remains a major element of a North Slope Borough preferred alternative. Nothing in this DEIS precludes addressing this range of issues before creating a new set of intervening third party legal rights in the form of oil and gas leases or special designations.

The North Slope Borough is on record strongly opposed to any alternative or mix of alternatives which involve additional withdrawals or designations which prevent subsistence activity or properly-regulated oil and gas development in NPR-A or the Planning Area.

Of paramount concern to the NSB is the guaranteed and perpetual use, both individual and communal, of the land in NPR-A for the people who have always lived there. Unresolved land issues must be a priority undertaking.

The land and the Inupiat life are inseparable. The land and sea are the source of the Inupiat food and culture. Even so, the Inupiat have accommodated federal agency management, seismic surveys, film crews, recreational adventurers, oil and gas exploration, scientists of all types and now the potential for new leasehold interest in these lands, with development certain to come if commercial discoveries are made.

If the government does not deal with the issue of communal use of land for cultural purposes, traditional land use and more modern future uses in a way that allows the Inupiat lifestyle to flourish, then the federal government will have failed the Inupiat people in the process.

Thank you for listening to and learning from the residents of the North Slope.

For more information on the North Slope and its people, please contact:

Mayor Ben Nageak

Public Information on NPR-A

Box 69

Barrow, AK 99723

650

BIBLIOGRAPHY

BLANK PAGE

BIBLIOGRAPHY

Abbott, S.M., ed. 1993. Caribou. Federal Aid in Wildlife Restoration, Annual Performance Report Vol. XXIV Part XI Project W-24-1, Study 3.0. Juneau, AK: State of Alaska, Dept. of Fish and Game.

Adams, D. Finally Nuiqsut Speaks Its Peace About NPR-A. In: *The Arctic Sounder*, April 17, 1997, p. 5, 9.

Ahern, D. 1997. Telephone Conversation of Apr. 28, 1977.

Ahmakak, M. 1982. Testimony at the Public Hearing on the Beaufort Sea Sale 71 DEIS. Feb. 3, 1982, Nuiqsut, Ak. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 35 pp.

Ahmakak, M. 1983. Testimony at the Public Teleconference for the Proposed Arctic Sand and Gravel Lease Sale. Jan. 4, 1983, Anchorage, Ak. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 22 pp.

Ahtuangaruak, R. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Nuiqsut, Alaska, Thursday, April 10, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM, 28 pp.

Ahvakana, N. Tesimony at the Public Hearing on the Beaufort Sea Sale 124 DEIS. Apr. 19, 1990, Nuiqsut, Ak. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 46 pp.

Aiken, J. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Barrow, Alaska, Monday, March 17, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM, 25 pp.

Akootchook, S. 1995. Beaufort Sea Sale 144 Outreach Meeting in Kaktovik, AK, Jul. 11, 1995. Michael Burwell's Trip Report. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Akootchook, S. 1996 (Testimony). Public Scoping for the Beaufort Sea Sale 170 Draft EIS, Kaktovik, Alaska, November 12, 1996. Minerals Management Service. Anchorage, AK: USDOI, MMS. Trip Report Notes.

Alaska Consultants, Inc., C.S. Courtnage, and Stephen R. Braund and Associates. 1984. Barrow Arch Socioeconomic and Sociocultural Description. Technical Report No. 101. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program, 641 pp.

Alaska Consultants, Inc. and Stephen R. Braund and Associates. 1984. Subsistence Study of Alaska Eskimo Whaling Villages. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Socioeconomic Studies Program, 248 pp. plus appendices.

Alaska Natives Commission. 1994. Joint Federal-State Commission on Policies and Programs Affecting Alaska Natives, Final Report. 3 Vols. Anchorage, AK: Alaska Natives Commission.

Alaska Report. 1997. ARCO Boosts Estimate of Alpine Field Reserves to 365 Million Barrels of Oil. *Alaska Report* 43(19): 1.

Alaska Report. 1996. New North Slope Field (Alpine) Boasts 250-300 Million Barrels in Oil Reserves. *Alaska Report* 42(41): 1-3.

Allen, A.A. 1991. Controlled Burning of Crude Oil on Water Following the Grounding of the *Exxon Valdez*. *In*: Proceedings of the 1991 International Oil Spill Conference (Prevention, Behavior, Control, Cleanup). Mar. 4-7, 1991, San Diego, Calif. API Publication No. 4529. Washington, DC: USCG, API, and USEPA, pp. 213-16.

Allen, G.H. 1988. Observations on the 1987 Subsistence Harvest of Northen Fur Seals on St. Paul Island, Pribilof Islands, Alaska. *In*: Oceans '88. A Partnership of Marine Interests, Proceedings. Oct. 31-Nov. 2, 1988, Baltimore, Md. Piscataway, NJ: Institute of Electrical and Electronics Engineers, pp. 1,079-1,082, 1,732 pp.

Alyeska Pipeline Service Company. 1997. Pipeline Facts, Throughput. Washington, D.C.: Roger Staiger, Alyeska Washington, D.C. Representative.

American Institute of Biological Sciences. 1976. Proceedings of a Symposium: Sources, Effects, and Sinks of Hydrocarbons in the Aquatic Environment. Aug. 9-11, 1976, Washington, D.C. Washington, DC: American Institute of Biological Sciences, 578 pp.

Armstrong, H. 1985. Field Notes of Helen Armstrong' (Anthropologist) Interviews With Rural Alaskans During 1982 and 1983.

Amstrup, S.C. 1993. Human Disturbance of Denning Polar Bears in Alaska. *Arctic* 46(3): 245-250.

Amstrup S.C. 1995. Movements, Distribution, and Population Dynamics of Polar Bears in the Beaufort Sea, a Thesis, Masters Thesis. Fairbanks, AK: University of Alaska, 299 pp.

Amstrup S.C. 1995. Movements, Distribution, and Population Dynamics of Polar Bears in the Beaufort Sea a Thesis, Ph.D. Dissertation. Fairbanks, AK: University of Alaska, 299 pp.

Amstrup, S.C. 1986. Research on Polar Bears in Alaska, 1983-1985. *In*: Polar Bears. Proceedings of the Ninth Working Meeting of the IUCN/SSC Polar Bear Specialist Group. Aug. 9-11, 1985, Edmonton, Alberta, Canada. Gland, Switzerland: International Union for Conservation of Nature and Natural Resources, pp. 85-115.

Amstrup, S.C. and C. Garner. 1994. Polar Bear Maternity Denning in the Beaufort Sea. *Journal Wildlife Management* 58(1): 1-10.

Amstrup, S.C., C. Garner, and G.M. Durner. 1992. Temporal and Geographic Variation of Maternity Denning Among Polar Bears of the Beaufort Sea. *In*: Research on the Potential Effects of Petroleum Development on Wildlife and Their Habitat, Arctic National Wildlife Refuge. T.R. McCabe, B. Griffith, N.E. Walsh, and D.D. Young, *ed.* Interim Report 1988-1990. Terrestrial Research 1002 Area-Arctic National Wildlife Refuge. Anchorage, AK: USDOI, FWS, Alaska Fish and Wildlife Research, pp. 165-206.

Amstrup, S.C., I. Stirling, and J.W. Lentfer. 1986. Past and Present Status of Polar Bears in Alaska. *Wildlife Society Bulletin* 14(3): 241-254.

Anderson, B.A.S.A.A.R.R.I. 1996. Avian Studies in the Kuparuk Oilfields, Alaska, 1995. Final Report. Fairbanks AK: ARCO Alaska, Inc. and the Kuparuk River Unit.

Anderson, B.A. and B.A. Cooper. 1994. Distribution and Abundance of Spectacled Eiders in the Kuparuk and Milne Point Oilfields, Alaska, 1993. Final Report prepared for ARCO Alaska, Inc., and the Kuparuk River Unit, Anchorage AK by Alaska Biological Research, Inc. Fairbanks AK. Final Report. Fairbanks AK: ARCO Alaska, Inc.

Anderson, C.M. and R.P. Labelle. 1994. Comparative Occurrence Rates for Offshore Oil Spills. *Spill Science and Technology Bulletin* 1(2): 131-141.

Anderson, C.M. and E.M. Lear. 1994. MMS Worldwide Tanker Spill Database: An Overview. OCS Report, MMS 94-0002. Herndon, VA: USDOI, MMS, 161 pp.

Anderson, D.D. 1968. A Stoneage Campsite at the Gateway to America. *American* 218(6): 24-33.

Andres, B.A. Coastal Zone Use by Postbreeding Shorebirds in Northern Alaska. Journal of Wildlife Management. 1994; 58(2):206-213.

Angerbjorn A., B. Arvidson, E. Noren, and L. Stromgren. 1991. The Effect of Winter Food on Reproduction in the Arctic Fox, *Alopex Lagopus*: A Field Experiment. *Journal of Animal Ecology* 60: 705-714.

Archibald W.R., Ellis R. and Hamilton A.N. 1987. Responses of Grizzly Bears to Logging Truck Traffic in the Kimsquit River Valley, British Columbia. *In*: Seventh International Conference on Bear Research and Management, P. Zager, ed. February 1986, Williamsburg, Va. Knoxville, TN: University of Tennessee, pp. 251-57.

ARCO Alaska, Inc. 1996. Alpine Development Project: Environmental Evaluation Document. 2 Vols. Anchorage, AK: ARCO Alaska, Inc. Prepared by ARCO Alaska, Inc., Anadarko Petroleum Corp., and Union Texas Petroleum for USDOD, U.S. Army COE.

ARCO Alaska, I.A.P.C.U.T.P.A.C. 1996. Alpine Development Project Environmental Evaluation Document. Final Report prepared for ARCO Alaska, Inc. and the Kuparuk River Unit, Anchorage, AK, by Alaska Biological Research, Inc. Fairbanks, AK. Anchorage, AK: ARCO Alaska, Inc.

Arnborg, L., H.J. Walker, and J. Peippo. 1966. Water Discharge in the Colville River, 1962. *Geografiska Annaler* 48A: 195-210.

Arundale, W.H. and W.S. Schneider. 1987. Quliaqtuat Nunaninnin: The Report of the Chipp-Ikpikpuk River and Upper Mead River Oral History Project. Barrow, AK: North Slope Borough, Commission on History, Language, and Culture.

Attanasi, E.D. and K.J. Bird. 1995. Economics and Undiscovered Conventional Oil and Gas Accumulations in the 1995 National Assessment of U.S. Oil and Gas Resources: Alaska. USGS Open-File Report 95-741. U.S. Geological Survey, 48 pp.

Bailey, A.M. 1948. *Birds of Arctic Alaska.* Denver CO: Colorado Museum of Natural History. Popular Series No. 8.

Bailey, E.P. and N.H. Faust. 1980. Summer Distribution and Abundance of Marine Birds and Mammals in the Sandman Reefs, Alaska. *The Murrelet* 61: 6-19.

Balogh, G. 1997. Spectacled Eiders, Threatened Seaduck on the NPR-A. *In*: NPR-A Symposium Proceedings-Science, Traditional Knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve In Alaska. Apr. 16-18, 1997, Anchorage, AK. OCS Study, MMS 97-0013. Anchorage, AK: USDOI, BLM and MMS, Alaska OCS Region, pp.

Balogh, G.R. and W.W. Larned. 1995. Comparing Three Years of Bird Population Indices From Aerial Surveys of the North Slope. Soldotna AK: USDOI, FWS, 4 pp.

Barsdate, R.J., V. Alexander, and R.E. Benoit. 1973. Natural Oil Seeps at Cape Simpson, Alaska: Aquatic Effects. *In*: Proceedings of the Symposium on the Impact of Oil Resource Development on Northern Plant Communities (23rd AAAS Alaska Science Conference). B.H. McCown and D.R. Simpson, Coordinators. August 17, 1972, Fairbanks, AK. Occasional Publication on Northern Life 1. Fairbanks, AK: University of Alaska, Fairbanks, Institute of Arctic Biology, 91-95.

Barsdate, R.J., M.C. Miller, V. Alexander, J.R. Vestal, and J.E. Hobbie. 1980. Oil Spill Effects. Limnology of Tundra Ponds. J. Hobbie, ed. Stroudsburg, PA: Dowden, Hutchinson and Ross, pp. 388-406.

Becker, P.R. and C.A. Manen. 1989. Natural Oil Seeps in the Alaskan Marine Environment [1988]. Outer Continental Shelf Environmental Assessment Program Final Report of Principal Investigators 62. Anchorage, AK: USDOC, NOAA, OCSEAP, Alaska Office, and USDOI, MMS, Alaska OCS Region, pp. 1-126.

Bee J.W. and E.R. Hall. 1956. Mammals of Northern Alaska on the Arctic Slope. University of Kansas Museum of Natural History Miscellaneous Publications 8. University Kansas. University Kansas, 309 pp.

Bendock, T.N. 1997. Fish Resources of the Northeastern NPR-A. *In*: NPR-A Symposium Proceedings - Science, Traditional Knowledge, and the Resources of the Northeastern Planning Area of the National Petroleum Reserve - Alaska. Apr. 16-18, 1997, Anchorage, AK. OCS Study MMS 97-0013. Anchorage, AK: USDOI, BLM and MMS, Alaska OCS Region.

Bendock, T.N. 1979. Inventory and Cataloging of Arctic Area Waters. Federal Aid in Fisheries Restoration Annual Performance Report G-I-I No. 20. Anchorage, AK: State of Alaska, Dept. of Fish and Game, pp. 50-52.

Bendock, T.N. and J.M. Burr. 1984. Freshwater Fish Distributions in the Central Arctic Coastal Plain (Ikpikpuk River to Colville River). Fairbanks, AK: State of Alaska, Dept. of Fish and Game, Sport Fish Div.

Benson, C.S. 1982. Reassessment of Winter Precipitation on Alaska's Arctic Slope and Measurements on the Flux of Wind-Blown Snow. Rep. UAG R-288. Fairbanks, AK: University of Alaska, Fairbanks, Geophysical Institute.

Bente P. 1996. Western Alaska Wolf Population Management Unit 26A. *In*: *Wolf*, M.V. Hicks, ed. Grant W-24-4 Study 14.0. ADF&G Division Wildlife Conservation Federal Aid in Wildlife Restoration Annual Performance Report of Survey-Inventory Activities 1 July 1995-30 June 1996. Juneau AK: State of Alaska, Dept. of Fish and Game, 23 pp.

Bergerud A.T. 1987. An Assessment of Petroleum on the Status of the Porcupine Caribou Herd. In: Arctic National Wildlife Refuge, Alaska Coastal Plain Resource Assessment. Report and Recommendation to the Congress of the US and Final Legislative Environmental Impact Statement Vol 2Appendix, Public Comments and Responses: USDOI, FWS, pp 4-19.

Bergerud, A.T. 1974. The Role of the Environment in the Aggregation, Movement, and Disturbance Behavior of Caribou. *In*: The Behavior of Ungulates and Its Relation to Management, V. Geist and F. Walter, eds. New Series No. 2, Vol. 2. IUCN, pp. pp. 552-84.

Bergerud A.T. and J.P. Elliot. 1986. Dynamics of Caribou and Wolves in Northern British Columbia. *Canadian Journal Zoology* 64: 1515-1529.

Bergman, R.D., R.L. Howard, K.F. Abraham, and M.W. Weller. 1977. Water Birds and Their Wetland Resources in Relation to Oil Development at Storkerson Point, Alaska. Resource Publication 129. Washington, DC: USDOI, FWS, 38 pp.

Bergmann, R.D., Howard, R.L., Abraham, K.F., and Weller, M.W. (USFWS). Waterbirds and Their Wetland Resources in Relation to Oil Development at Storersen Point, Alaska. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service, 1977. Resources Publication 129. 38 pp.

Birchard, E. and R. Nancarrow. 1986. The Minuk I-53 Artificial Island Oil Spill. In: Proceedings of the Ninth Arctic Marine Oil Spill Program Technical Seminar. June 10-12, 1986, Edmonton, Alberta, Canada. Ottawa, Ontario, Canada: Environment Canada, Conservation and Protection, pp. 375-78.

Bird, K.J. 1988. Alaskan North Slope Stratigraphic Nomenclature and Data Summary for Government-Drilled Wells. *In*: Geology and Exploration of the National Petroleum Reserve in Alaska, 1974 to 1982, G. Gryc, Ed. Washington, DC: United States, DOI, GS, pp. 317-353.

Bird, K.J. 1994. Ellesmerian! Petroleum System, North Slope of Alaska, U.S.A. *In*: *The Petroleum System-From Source to Trap*, L.B. Magoon and W.G. Dow, eds. Memoir 60. American Association of Petroleum Geologists, pp. 339-358.

Bird, K.J. 1988a. The Geologic Basis for Appraising Undiscovered Hydrocarbon Resources in the NPR-A. *In*: *Geology and Exploration of the National Petroleum Reserve in Alaska, 1974-1982*, G. Gryc, ed. USGS Professional Paper 1399. U.S. Geological Survey, pp. 81-116.

Bird, K.J. 1995. Northern Alaska Province. *In*: *1995 National Assessment of United States Oil and Gas Resources*, D.L. Gautier, G.L. Dolton, K.I. Takahashi, and K.L. Varnes, eds. Digital Data Series 30. CD-ROM: U.S. Geological Survey.

Bird, K.J. 1988. Structure-Contour and Isopach Maps of the National Petroleum Reserve in Alaska. *In*: Geology and Exploration of the National Petroleum Reserve in Alaska, 1974-1982, G. Gryc, ed. U.S. Geological Survey Professional Paper 1399. U.S. Geological Survey, pp. 355-377.

Bird, K.J. 1988b. Structure-Contour and Isopach Maps of the National Petroleum Reserve in Alaska. *In*: *Geology and Exploration of the National Petroleum Reserve in Alaska, 1974-1982*, G. Gryc, ed. USGS Professional Paper 1399. U.S. Geological Survey, pp. 355-377.

Bird, K.J. and C.M. Molenaar. 1992. The North Slope Foreland Basin, Alaska. *In*: *Foreland Basins and Foldbelts*, R. Macqueen and D. Leckie, eds. Memoir 55. American Association of Petroleum Geologists, pp. 363-393.

Bird, K.J. and R.B. Powers. 1988. Comparison of Six Assessments of the Hydrocarbon Resources of the National Petroleum Reserve in Alaska. *In: Geology and Exploration of the National Petroleum Reserve in Alaska, 1974-1982*, G. Gryc, ed. USGS Professional Paper 1399. U.S. Geological Survey, pp. 77-80.

Bishop, R.H. 1967. Reproduction, Age Determination, and Behavior of the Harbor Seal (*Phoca Vitulina L.*) in the Gulf of Alaska. M.S. Thesis. College, AK: University of Alaska.

Bockstoce, J. 1978. History of Commercial Whaling in Arctic Alaska. *Alaska Geographic* 5(4): 17-26.

Bockstoce, J., M. Freeman, Laughlin, W.S. Nelson, M. Orbach, R. Peterson, J.G. Taylor, and R. Worl. 1979. Report of the Panel to Consider Cultural Aspects of Aboriginal Whaling in North America. Seattle, WA. Feb. 5-9, 1979, under the auspices of the International Whaling Commission.

Boehm, P.D., M.S. Steinhauer, E.A. Crecelius, J. Neff, and C. Tuckfield. 1987. Analysis of Trace Metals and Hydrocarbons From Outer Continental Shelf (OCS) Activities. Final Report on the Beaufort Sea Monitoring Program. OCS Study, MMS 87-0072. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 2 volumes.

Bogart, J. 1997. Telephone Conversation Dated Apr. 18, 1997, From J. Tremont, Geographer, USDOI, MMS, Alaska OCS Region, to Jim Bogart, Alyeska Pipeline Service Co., Control Center Lead; Subject.

Bollinger, K.S. and Derksen, D.V., Demographic Characteristics of Molting Black Brant near Teshekpuk Lake, Alaska. Journal of Field Ornithology. 1996, 67(1):141-158.

Bond, W.A. 1982. A Study of the Fishery Resources of Tuktoyaktuk Harbour, Southern Beaufort Sea Coast, With Special Reference to Life Histories of Anadromous Coregonids. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1119. Winnipeg, Manitoba, Canada: Canadian Dept of Fisheries and Oceans, Western Region, 90 pp. plus.

Bowyer, R.T., J.W. Testa, J.B. Faro, and L.K. Duffy. 1993. Effects of the *Exxon Valdez* Oil Spill on River Otters in Prince William Sound. *In: Exxon Valdez* Oil Spill Symposium Abstract Book, B. Spies, L.J. Evans, B. Wright, M. Leonard, and C. Holba, eds. and comps. Feb 2-5, 1993, Anchorage, AK. Anchorage, AK: *Exxon Valdez* Oil Spill Trustee Council; UAA, University of Alaska Sea Grant College Program; and American Fisheries Society, Alaska Chapter, pp. 297-99.

Brabets, T.P. 1996. Evaluation of the Streamflow-Gaging Network of Alaska in Providing Regional Streamflow Information. USGS Water Resources Investigations Report 96-4001. U.S. Geological Survey, 73 pp.

Brackney, A.W. and R.J. King. 1993. Aerial Breeding Pair Surveys of the Arctic Coastal Plain of Alaska: Revised Estimates of Waterbird Abundance 1986-1992. Unpublished report. Anchorage, AK: USDOI, FWS, 21 pp.

Brackney, A.W. and R. J. King. 1995. U.S. Fish and Wildlife Service, Migratory Bird Management. Aerial Breeding Pair Surveys of the Arctic Coastal Plain of Alaska: Distribution and Abundance 1995. Fairbanks, AK: U.S. Fish and Wildlife Service; 1996, 14 pp.

Brosge, W.P. and I.L. Tailleur. 1971. Northern Alaska Petroleum Province. *In: Future Petroleum Provinces of the United States-Their Geology and Potential*, I.H. Cram, ed. Memoir 15. American Association of Petroleum Geologists, pp. 68-99.

Brouwers, E.M., W.A. Clemmens, R.A. Spicer, T.A. Ager, L.D. Carter, and W.V. Sliter. 1987. Dinosaurs of the North Slope, Alaska: High Latitude, Latest Cretaceous Environments. *Science* 237: 1608-1610.

Brower, A., Sr. 1987. In: Arundale, W.H. and W.S. Schneider. Quliaqtuat Inupiat Nunaninnin: The Report of the Chipp-Ikpikpuk River and Upper Mead River Oral History Project. A Report for the North Slope Borough Commission on History, Language, and Culture.

Brower, A., Jr. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Atqasuk, Alaska, Tuesday, March 18, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM, 17 pp.

Brower, C. 1986. Testimony at the Public Hearing on Oil and Gas Lease Sale 97, Dec. 8, 1986, Barrow, Ak. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 57 pp.

Brower, C.D. 1942. *Fifty Years Below Zero*. New York: Dodd, Mead and Co.

Brower E. 1983. Letter of 1983 From E. Brower, North Slope Borough, to A. Powers, Regional Director, USDOI, MMS, Alaska OCS Region, Subject: Public Testimony for the Diapir Field Lease Offering FEIS.

Brower, H., Jr. and R.T. Opie. 1997. North Slope Borough Subsistence Harvest Documentation Project: Data for Nuiqsut, Alaska for the Period July 1, 1994 to June 30, 1995. Barrow, AK: North Slope Borough, Department of Wildlife Management.

Brower, H., Jr. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Barrow, Alaska, Monday, March 17, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM, 25 pp.

Brower, T., Jr. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Atqasuk, Alaska, Tuesday, March 18, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM, 17 pp.

Brower, W.A. Jr., R.G. Baldwin, C.N. Williams, Jr., J.L. Wise, and L.D. Leslie. 1988. Climatic Atlas of the Outer Continental Shelf Waters and Coastal Regions of Alaska, Vol III, Chukchi-Beaufort Sea. OCS Report, MMS 87-0013, and NAVAIR 50-1C-553. Asheville, NC; and Anchorage, AK: USDOD, NOCD; USDOI, MMS, Alaska OCS Region; and USDOC, NOAA, NOS, 530 pp.

Burch, E.S., Jr. 1970. The Eskimo Trading Partnership in North Alaska: A Study in Balanced Reciprocity. *Anthropological Papers of the University of Alaska* 15(1):49-80.

Burch, E.S., Jr. 1975. *Eskimo Kinsmen: Changing Family Relationships in Northwest Alaska*. St. Paul, New York, Boston, Los Angeles, San Francisco: West Publishing Company.

Burch, E.S., Jr. 1971. The Nonempirical Environment of the Arctic Alaskan Eskimos. *Southwestern Journal of Anthropology* 27(2).

Burch, E.S., Jr. 1975. *Eskimo Kinsmen: Changing Family Relationships in Northwest Alaska*. St. Paul, New York, Boston, Los Angeles, San Francisco: West Publishing Company.

Burger, A.E. and D.M. Fry. 1993. Effects of Oil Pollution on Seabirds in the Northeast Pacific. *In*: The Status, Ecology and Conservation of Marine Birds of the North Pacific, K. Vermeer, K.T. Briggs, K.H. Morgan, and D. Siegel-Causey, eds. CW66-124-1993E. pp 254-263. Ottawa, Canada: Canadian Wildlife Service.

Burgess R. M. P.W. Banyas , authors. 1993. Inventory of Arctic Fox Dens in the Prudhoe Bay Region 1992. Northern Alaska Research Studies. Fairbanks AK: Alaska Biological Research Inc, pp 89.

Burgess R.M., R. Rose, P.W. Banyas, and B.E. Lawhead. 1993. Arctic Fox Studies in the Prudhoe Bay Unit and Adjacent Undeveloped Areas 1992. Northern Alaska Research Studies. Fairbanks AK: Alaska Biological Research, Inc., 16 pp.

Burnell, K. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Atqasuk, Alaska, Tuesday, March 18, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM, 17 pp.

Burns, J.J., L.H. Shapiro, and F.H. Fay. 1981. Ice As Marine Mammal Habitat in the Bering Sea. *In*: The Eastern Bering Sea Shelf: Oceanography and Resources, D.W. Hood and J.A. Calder, eds Vol. II. Juneau, AK: USDOC, NOAA, OMPA, and USDOI, BLM, pp. 781-797.

Calef, G., E. DeBock, and G. Lortie. 1976. The Reaction of Barren-Ground Caribou to Aircraft. *Arctic* 29: 201-212.

Cameron, R.D. 1994. Distribution and Productivity of the Central Arctic Caribou Herd in Relation to Petroleum Development: Case History Studies With a Nutritional Perspective. Study 3.35. Federal Aid in Wildlife Restoration Research Final Report Study 3.35, Grant w-23-1, w-23-2, w-23-3, w-23-4, w-23-5, w-24-1, w24-2, w-24-3. Juneau, AK: ADF&G, Division of Wildlife Conservation, 35pp.

Cameron R.D., L.E.A.R.D.J.W.K.R.a.S.W.T. 1995. Abundance and Movements of Caribou in the Oilfield Complex Near Prudhoe Bay, Alaska. *Rangifer* 15(1): 3-8.

Cameron R.D. W.T. Smith, author. 1992. Distribution and Productivity of the Central Arctic Herd in Relation to Petroleum Development Case History Studies With a Nutritional Perspective. Research Progress Report Project W23-5 Study 3.35. ADF&G Division Wildlife Conservation Federal Aid Wildlife Restoration. Juneau AK: ADF&G, 34 pp.

Cameron R.D., W.K.R.a.S.W.T. 1986. Summer Range Fidelity of Radio-Collared Caribou in Alaska's Central Arctic Herd. in: Development and Alteration of Caribou Movement Patterns. Federal Aid in Wildlife Restoration, Research Progress Report Project W-22-4. Juneau AK: ADF&G, 45pp.

Cameron, R.D., D.J. Reed, J.R. Dau, and Smith W.T. 1992. Redistribution of Calving Caribou in Response to Oil Field Development on the Arctic Slope of Alaska. *Arctic* 45(4): 338-342.

Cameron, R.D., K.R. Whitten, and W.T. Smith. 1981. Distribution and Movement of Caribou in Relation to the Kuparuk Development Area. Preliminary Report and Second and Third Interim Reports, 1980-1981. State of Alaska, Dept. of Fish and Game.

Cameron, R.D., K.R. Whitten, and W.T. Smith. 1983. Responses of Caribou to Petroleum-Related Development on Alaska's Arctic Slope. Progress Report, Vol. VII. Federal Aid in Wildlife Restoration Research Program Project W-21-2 and W-22-1, Job 3, 18R. State of Alaska, Dept. of Fish and Game, Div. of Game, 75 pp.

Cannon, T.C., D.R. Glass, and C.M. Prewitt. 1991. Habitat Use Patterns of Juvenile Arctic Cod in the Coastal Beaufort Sea Near Prudhoe Bay, Alaska. *In*: The Eleventh American Fisheries Society Symposium, Fisheries and Oil Development on the Continental Shelf, C.S. Benner and R.W. Middleton, eds. American Fisheries Society Symposium 11. Bethesda, MD: American Fisheries Society, pp 157-162.

Carlson, H.R. and R.R. Straty. 1981. Habitat and Nursery Grounds of Pacific Rockfish, *Sebastes Spp* in Rocky Coastal Areas of Southeastern Alaska. *Marine Fisheries Review* 43(7): 13-19.

Carroll, G. 1991. Game Management Unit 26A Western North Slope. *In*: Brown Bear, S.M. Abbott, ed. Project W-23-4, Study 4.0. ADF&G Division Wildlife Conservation Federal Aid Wildlife Restoration Annual Performance Report of Survey-Inventory Activities 1 July 1990- 30 June 1991 XXII Part V. Juneau, AK: State of Alaska, Dept. of Fish and Game , 271pp.

Carroll, G. 1994. Western North Slope Game Management Unit 26A. *In*: Wolf, M.V. Hicks, ed. Study 140. Grant W-23-5, W-24-1, W-24-2. ADF&G Federal Aid in Wildlife Restoration Survey-Inventory Management Report 1 July 1991 - 30 June 1993. Juneau AK: State of Alaska, Dept. of Fish and Game, 204 pp.

Carroll, G. 1992. Teshekpuk Lake Caribou Herd, Game Management Unit 26A. *In*: Caribou Surveys-Inventory Management Report, 1 July 1989-30 June 1991, S.M. Abbott, ed. Caribou Survey-Inventory Management Report 1 July 1989-30 June 1991. ADF&G Federal Aid in Wildlife Restoration. Project W-23-1 and W-23-4 Study 3.0. Juneau AK: State of Alaska, Dept. of Fish and Game.

Carruthers, D.R., R.D. Jakimchuk, and S.H. Ferguson. 1984. The Relationship Between the Central Arctic Caribou Herd and the Trans-Alaska Pipeline. Anchorage, AK: Alyeska Pipeline Company, 207 pp.

Casey, P. 1997. Summary Memorandum of Meeting of Thomas Napageak and MMS in Anchorage, Alaska, January 10, 1997 on a possible Sale 170 Nuiqsut deferral.

Chance, N.A. 1966. *The Eskimo of North Alaska*. New York: Holt, Rinehart and Winston.

Chance, N.A. 1990. *The Inupiat and Arctic Alaska*. Fort Worth, TX: Holt, Rinehart and Winston.

Chapin, F.S., III, R.J. Barsdate, and D. Barel. 1978. Phosphorus Cycling in Alaskan Coastal Tundra: a Hypothesis for the Regulation of Nutrient Cycling. *Oikos* 31:189-199.

Chesemore, D.L. 1967. Ecology of the Arctic Fox in Northern and Western Alaska. Fairbanks AK: University of Alaska, 148 pp.

Chester, R. 1965. Elemental Geochemistry of Marine Sediments. J.P. Riley and G. Skirrow, eds. *Chemical Oceanography 2*: 23-80.

Childers, J.M., D.R. Kernodle, and R.M. Loeffler. 1979. Hydrologic Reconnaissance of Western Arctic Alaska, 1976 and 1977. Open-File Report 79-699. Anchorage, AK: U.S. Geological Survey, 70 pp.

City of Nuiqsut. 1995. Nuiqsut Paisanich: A Cultural Plan. Nuiqsut, AK: City of Nuiqsut, Native Village of Nuiqsut, and the Kuukpik Corp.

Clemens, W.A. and L.G. Nelms. 1993. Paleontological Implications of Alaskan Terrestrial Vertebrate Fauna in Latest Cretaceous Time at High Paleolatitudes. *Geology* 21:503-506.

Clough N.K., P.C. Patton, A.C. Christiansen, editors. 1987. Arctic National Wildlife Refuge Alaska Coastal Plain Resource Assessment Report and Recommendation to the Congress of the United States and Final Legislative Environmental Impact Statement Vol 1. Washington D.C.: USF&W, 208 pp.

Clow, G. 1997. Telephone Conversation Dated May 30, 1997, Between Gary Clow, USGS, and Don Meares, USDOI, BLM. Subject: Short History of Well Logging Program.

Coady, J.W. 1980. History of Moose in Northern Alaska and Adjacent Regions. *Canadian Field Naturalist* 94(1): 61-68.

Connors, P.G., C.G. Connors, and K.G. Smith. 1981. Shorebird Littoral *Zone* Ecology of the Alaskan Beaufort Sea Coast. OCSEAP Final Reports of Principal Investigators, Vol. 23(Oct. 1984). Anchorage, AK: USDOC, NOAA, and USDOI, MMS, pp. 295-396.

Cook Inlet Region, Inc. and Westmin Resources, Limited. 1994. Johnson Tract, Transportation and Port Easements Identification: An Environmental Analysis. Washington, DC: USDOI, Office of the Secretary, and NPS.

Craig, J.D., K.W. Sherwood, and P.P. Johnson. 1985. Geologic Report for the Beaufort Sea Planning Area, Alaska: Regional Geology, Petroleum Geology, Environmental Geology. OCS Report, MMS 85-0111. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 192 pp.

Craig, P.C. 1984. Fish Use of Coastal Waters of the Alaskan Beaufort Sea: A Review. *Transactions of the American Fisheries Society* 113: 265-282.

Craig, P.C. 1989. An Introduction to Anadromous Fishes in the Alaskan Arctic. *In*: Biological Papers of the University of Alaska, D.W. Norton, ed. Research Advances on Anadromous Fish in Arctic Alaska and Canada - Nine Papers Contributing to an Ecological Synthesis Number 24. Fairbanks, AK: University of Alaska, Fairbanks, Institute of Arctic Biology, pp. 27-54, 166 pp.

Craig, P.C. 1987. Subsistence Fisheries at Coastal Villages in the Alaskan Arctic, 1970-1986. Technical Report No. 129. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Social and Economic Studies.

Craig, P.C. 1987. Subsistence Fishers at Coastal Villages in the Alaskan Arctic, 1970-1986. Technical Report No. 129, Alaska OCS Social and Economic Studies. Prepared by LGL Ecological Research Associates, Inc. for USDOI, MMS. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 93 pp.

Craig, P.C., W.B. Griffiths, S.R. Johnson, and D.M. Schell. 1984. Trophic Dynamics in an Arctic Lagoon. *In*: The Alaskan Beaufort Sea Ecosystems and Environments, P.W. Barnes, D.M. Schell, and E. Reimnitz, eds. New York: Academic Press, Inc., pp. 347-380.

Craig, P.C. and L. Haldorson. 1981. Beaufort Sea Barrier Island-Lagoon Ecological Processes Studies: Final Report, Simpson Lagoon, Part 4, Fish. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators, Vol. 7 Biological Studies(Feb. 1981). Boulder, CO: USDOC, NOAA, OCSEAP, and USDOI, BLM, pp. 384-678.

Curatolo J.A., author. 1984. A Study of Caribou Response to Pipelines In and Near the Eileen West End, 1983. Fairbanks AK. ABR.

Dau, C.P. and S.A. Kistchinski. 1977. Seasonal Movements and Distribution of the Spectacled Eider. *Wildfowl* 28: 65-75.

Dau J.R. R.D.Cameron, author. 1986. Responses of Barren-Ground Caribou to Petroleum Development Near Milne Point, Alaska. Final Report prepared for Conoco Inc & Continental Pipeline Co. Fairbanks AK. ADF&G.

Dau, J.R. and R.D. Cameron. 1986. Responses of Barren-Ground Caribou to Petroleum Development Near Milne Point, Alaska. Final Report. Fairbanks, AK. State of Alaska, Dept. of Fish and Game.

Davis J.L., author. 1978. History and Current Status of Alaska Caribou Herds, Parameters of Caribou Population Ecology in Alaska. in Proceedings of a Symposium and Workshop, D.R. Klein R.G. White, editors. Special Report No 3. Biological Papers of the University of Alaska. Fairbanks AK. University of Alaska.

Davis, J.L., P. Valkenburg, and R. Boertje. 1982. Home Range Use, Social Structure and Habitat Selection of the Western Arctic Caribou Herd. Fairbanks AK. USDOI, National Park Service.

Davis, J.L., P. Valkenburg, and H.V. Reynolds. 1980. Population Dynamics of Alaska's Western Arctic Caribou Herd. AlnA. Proceedings of the Second International Reindeer/Caribou Symposium, E. Reimers, E. Gaare, and S. Skenneberg, eds. September 17-21, 1979, Roros, Norway. Trondheim, Norway. Direktoratet for vilt og ferskvannsfisk.

Davis, R.A., K.J. Finley, and W.J. Richardson. 1980. The Present Status and Future Management of Arctic Marine Mammals in Canada. Science Advisory Board of NWT Vol. 3. Yellowknife, N.W.T. Government of the Northwest Territories, Dept. of Information. 93 pp. Available from Science Advisory Board of Northwest Territories, Box 1617, Yellowknife, N.W.T., Canada.

Dekin, A.A., Jr. 1993. Exxon Valdez Oil Spill Archaeological Damage Assessment, Management Summary, Final Report. Contract No. 53-0109-1-00325. Juneau, AK. USDA, Forest Service.

Derksen, D.V., M.W. Weller, and W.D. Eldridge. 1979. Distributional Ecology of Geese Molting Near Teshekpuk Lake, National Petroleum Reserve-Alaska. *In*: Management and Biology of Pacific Flyway Geese. A Symposium. Portland, OR. Oregon State University, pp. 189-207.

Derksen, D.V., Rothe, T.C., and Eldridge, W.D. (USFWS). Use of Wetland Habitats by Birds in the National Petroleum Reserve-Alaska. Washington, DC. U.S. Fish and Wildlife Service, 1981, USFWS Resource Publication 141. 25 pp.

Derocher A.E. I. Stirling. 1991. Oil Contamination of Polar Bears. *Polar Record* 27(160): 56-57.

Dunton, K.H., E. Reimnitz, and S. Schonberg. 1982. An Arctic Kelp Community in the Alaskan Beaufort Sea. *Arctic* 35(4): 465-484.

Eastland, W.G., R.T. Bowyer, and S.G. Fancy. 1989. Effects of Snow Cover on Selection of Calving Sites by Caribou. *Journal of Mammalogy* 70: 824-828.

Eberhardt, L.E., W.C.B.J.L. Hanson, R.A. Garrott, and E.E. Hanson. 1982. Arctic Fox Home Range Characteristics in an Oil-Development Area. *Journal Wildlife Management* 46(1): 183-190.

Edwardson, R. 1995. Testimony at the Public Hearing on the Beaufort Sea Sale 144 DEIS, Nov. 8, 1995, Barrow, Ak. Anchorage, AK. USDOI, MMS, Alaska OCS Region. 101 pp.

Eide S.H., M.S.D.a.C.M.A. 1986. Oil Pipeline Crossing Sites Utilized in Winter by Moose, Alces and Caribou Rangifer Tarandus, Southcentral Alaska. *Canadian Field Naturalist* 100(2): 197-207.

Elison G.W. A.G. Rappoport, G.M. Reid, author. 1986. Report on the Caribou Impact Analysis Workshop. Arctic National Wildlife Refuge November 19-20. November 19 & 20, Fairbanks Ak. Fairbanks AK. USDOI USF&W.

Embry, A.F. 1990. Geological and Geophysical Evidence in Support of the Hypothesis of Anticlockwise Rotation of Northern Alaska. *Marine Geology* 93: 317-329.

Emers, M. and J.C. Jorgenson. 1997. Effects of Winter Seismic Exploration on the Vegetation and Soil Thermal Regime of the Arctic National Wildlife Refuge. *In*: Disturbance and Recovery in Arctic Lands. An Ecological Perspective. Dordrecht, The Netherlands. Kluwer Academic Publishers.

Endres, P.J. and L.A. Pavia. 1991. Evaluation of Oil Impacted Shoreline in the Kodiak/Alaska Peninsula Regions, Final Report 1989-1991. Anchorage, AK. State of Alaska, DEC, 128 pp.

Entrix, Inc. 1986. Colville River Fish Study. 1985 Annual Report, May 1986. Anchorage, AK. ARCO Alaska, Inc., North Slope Borough, and City of Nuiqsut.

Environmental Science and Engineering, Inc. 1987. Kuparuk Aerometric Monitoring Program - Annual Data Summary. Anchorage, AK. ARCO Alaska, Inc., 20 pp.

ERE Systems, Ltd. 1984. Barrow Arch Transportation Systems Impact Analysis. Technical Report No. 104. Anchorage, AK. USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program, 312 pp. plus appendices.

Ericklook, B. 1979. Testimony at the Public Hearing on the BF Oil and Gas Lease Sale. Nuiqsut, Ak, May 16, 1979. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 37 pp.

Ericklook, J. 1990. Testimony at the Public Hearing on the Beaufort Sea Sale 124 DEIS, Apr. 19, 1990, Nuiqsut, Ak. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 46 pp.

ERT Company. 1987. Prudhoe Bay Air Quality Monitoring Program Quarterly and Annual Data Report. Report No. D816. Anchorage, AK: Standard Alaska Production Company, 68 pp.

Everett, K.R., D.L. Kane, and L.D. Hinzman. 1996. Surface Water Chemistry and Hydrology of a Small Arctic Drainage Basin. Landscape Function and Disturbance in Arctic Tundra. J.F. Reynolds and J.D. Tenhunen, eds. Berlin, Germany: Springer-Verlag, pp. pp. 185-201 437 pp.

Ewing, A.L. 11 June 1997. Letter to Johanna Munson, Alaska NPR-A Representative, United States DOI, BLM, Alaska State Office. Subject (NPR-A file)

Fall, J.A. 1983. Tyonek: Resource Uses in a Small, Non-Road Connected Community of the Kenai Peninsula Borough. *In*: Resource Use and Socioeconomic Systems: Case Studies of Fishing and Hunting in Alaskan Communities, R.J. Wolfe and L.J. Ellanna, Comps. Technical Paper No. 61. Juneau, AK: State of Alaska, Dept. of Fish and Game, Subsistence Div., pp. 202-218.

Fall, J.A. 1992. Changes in Subsistence Uses of Fish and Wildlife Resources in 15 Alaska Native Villages Following the *Exxon Valdez* Oil Spill. *In*: Conference Proceedings, Alaska OCS Region, Fourth Information Transfer Meeting, Jan. 28-30, 1992, Anchorage, Ak. Anchorage, AK: USDOI, MMS, AK OCS Region, pp. 261-70.

Fall, J.A. and C.J. Utermohle. 1995. An Investigation of the Sociocultural Consequences of Outer Continental Shelf Development in Alaska Vol. VI. Anchorage, AK: State of Alaska, Dept. of Fish and Game, Div. of Subsistence.

Foulks, E.F. and S. Katz. 1973. The Mental Health of Alaskan Natives. *Acta Psychiat. Scand.* 49:91-96.

Fay, F.H. and Follman. 1982. The Arctic Fox (*Alopex Lagopus*) Species Account3917. USDOC, NOAA, OCSEAP, 27 pp. RU 194.

Fay, F.H., B.P. Kelly, and J.J. Sease. 1989. Managing the Exploitation of Pacific Walruses: A Tragedy of Delayed Response and Poor Communication. *Marine Mammal Science* 5(1a): 1-16.

Fechhelm, R.G., M. Millard, W.B. Griffiths, and T. Underwood. 1996. Change in the Abundance Patterns of Arctic Flounder (*Pleuronectes Glacialis* Pallas, 1776) in the Coastal Waters of the Alaskan Beaufort Sea, 1982-1995. *In*: The 1996 Endicott Fish Monitoring Program, Synthesis Supplement Volume III: Published Literature for Synthesis. Final Draft. Anchorage, AK: BP Exploration (Alaska) Inc. and North Slope Borough.

Fechhelm, R.G., W.H. Neill, and B.J. Gallaway. 1991. Temperature Preference of Juvenile Arctic Cisco (Coregonus Autumnalis) From the Alaskan Beaufort Sea. *In*: The 1991 Endicott Development Fish Monitoring Program, Volume VII: Published Literature for Synthesis. Final Draft. Anchorage, AK: BP Exploration (Alaska) Inc. and North Slope Borough.

Federal Energy Regulatory Commission. 1995. Yukon Pacific LNG Project: Final Environmental Impact Statement. FERC/EIS-0071. Washington, DC: Federal Energy Regulatory Commission, Office of Pipeline Regulation.

Federal Register. 1993. Endangered and Threatened Wildlife and Plants: Final Rule to List Spectacled Eider As Threatened. *Federal Register* 58(88): 27,474-27,480. 50 CFR Part 17, May 10, 1993, USDOI, FWS.

Federal Register. 1994. Endangered and Threatened Wildlife and Plants: Proposed Rule to List Alaska Breeding Population of the Steller's Eider. *Federal Register* 59(134): 35896-900. 50 CFR Part 17, USDOI, FWS, July 14, 1994.

Federal Register. 1994. Endangered and Threatened Wildlife and Plants: Removal of Arctic Peregrine Falcon From the List of Endangered and Threatened Wildlife. *Federal Register* 59(192): 50,796-50,805. 50 CFR Part 17, USDOI, FWS.

Federal Register. 1985. Port Access Routes Study: Unimak Pass, Alaska. *Federal Register* 50(52): 10,877. U.S. Dept. of Transportation, U.S. Coast Guard, CGD 83-068.

Felix, N.A., M.K. Raynolds, J.C. Jorgenson, and K.E. DuBois. 1992. *Resistance and Resilience of Tundra Plant Communities to Disturbance by Winter Seismic Vehicles*. *Arctic and Alpine Research* 24: 69-77.

Fingas, M.F. 1996. The Evaporation of Oil Spills: Variation With Temperature and Correlation With Distillation Data. *In*: Proceedings of the Nineteenth Arctic and Marine Oilspill Program (AMOP) Technical Seminar, Jun. 12-14, 1996, Calgary, Alberta, Canada. Vol. 1. Ottawa, Ontario, Canada: Environment Canada, pp. 29-72.

Fingerman, S.W. 1980. Differences in the Effects of Fuel Oil, and Oil Dispersant, and Three Polychlorinated Biphenyls of Fin Regeneration in the Gulf Coast Killifish, *Fundulus Grandis*. *Bulletin of Environmental Contamination and Toxicology* 25: 134-240.

Finkler, E. 1997. Telephone Conversation Dated May 16, 1997 Between E. Finkler, Deputy Director of Planning, North Slope Borough, and John Tremont, Geographer, USDOI, MMS, Alaska OCS Region. Subject: Ice Roads.

659

Flint, P. 1997. Telephone Conversation in April 1997 Between P. Flint, NRB, and F. Wendling, USDOI, MMS, Alaska OCS Region; Subject: Steller's Eider Nesting on the Yukon-Kuskokwim Delta in 1994-1996.

Foote, D.C. 1964. American Whalemen in Northwestern Arctic Alaska. *Arctic Anthropology* 2(2): 16-20.

Frost, K.J. and L.F. Lowry. 1983. Demersal Fishes and Invertebrates Trawled in the Northeastern Chukchi and Western Beaufort Seas, 1976-1977. NOAA Technical Report NMFS SSRF-764. Seattle, WA: USDOC, NOAA, NMFS, 22 pp.

Frost, K.J. and L.F. Lowry. 1981. Marine Mammals. ÅInÅ. Proceedings of a Synthesis Meeting: Beaufort Sea (Sale 71) Synthesis, D.W. Norton and W.M. Sackinger, eds. April 21-23, 1981, Chena Hot Springs, AK. Juneau, AK: USDOC, NOAA, and USDOI, MMS, pp. 43-46.

Frost, K.J., L.F. Lowry, and J.J. Burns. 1988. Ringed Seals in the Beaufort Sea. Chapter 5. ÅInÅ. Beaufort Sea Information Update, P.R. Becker, ed. OCS Study, MMS 86-0047. Anchorage, AK: USDOC, NOAA, OCSEAP, and USDOI, MMS, Alaska OCS Region, pp. 41-49.

Frost K.J., L.F. Lowry, and G. Carroll. 1993. Beluga Whale and Spotted Seal Use of a Coastal Lagoon System in the Northeastern Chukchi Sea. *Arctic* 46(1): 8-16.

Gabrielson, I.N. and F.C. Lincoln. 1959. The Birds of Alaska. The Birds of Alaska. Harrisburg, PA: Stackpole Co. 922 pp. Wildlife Management Institute.

Gangloff, R.A. 1997. Paleontological Resources in the Northeast Planning Area of the NPR-A. Paper presented at the NPR-A Symposium: Environmental and Subsistence Resources in the Northeast Planning Area of the National Petroleum Reserve in Alaska. Apr. 16-18, 1997, Anchorage, AK. Anchorage, AK: USDOI, BLM, and MMS, Alaska OCS Region.

Gard, R. 1974. Aerial Census of Gray Whales in Baja California Lagoons, 1970 and 1973, With Notes on Behavior, Mortality and Conservation. *California Fish and Game Bulletin* 60(3): 132-134.

Garner, G.W. and P.E. Reynolds, eds. 1986. Impacts of Further Exploration, Development and Production of Oil and Gas Resources. *In:* Arctic National Wildlife Refuge Coastal Plain Resource Assessment. Final report. Baseline Study of Fish, Wildlife, and Their Habitats Vol. II. Anchorage AK: USDOI, FWS, 696 pp.

Garrott, R.A., L.L. Eberhardt, and D.M. Burn. 1993. Mortality of Sea Otters in Prince William Sound Following the Exxon Valdez Oil Spill. *Marine Mammal Science* 9(4): 343-359.

Gentry, R.L., E.C. Gentry, and J.F. Gilman. 1990. Responses of Northern Fur Seals to Quarrying Operations. *Marine Mammal Science* 6(2): 151-155.

George, J.C. and A.S. Fuller. In prep. Evaluation of Subsistence Harvest Data from the North Slope Borough 1993 Census for Eight North Slope Villages, for the Calendar Year 1992, Nuiqsut. Barrow, AK: North Slope Borough, Department of Wildlife Management.

George, J.C. and B.P. Nageak. 1986. Observations on the Colville River Subsistence Fishery at Nuiqsut, Alaska for the Period July 4-November 1, 1984. Barrow, AK: North Slope Borough, 25 pp.

George, J.C. and R. Kovalsky. 1986. Observations on the Kupigruak Channel (Colville River) Subsistence Fishery, October 1985. Barrow, AK: North Slope Borough, 60 pp.

George, J.C. and B.P. Nageak. 1986. Observations on the Colville River Subsistence Fishery at Nuiqsut, Alaska for the Period July 4-November 1, 1984. Barrow, AK: North Slope Borough, 25 pp.

Geraci, J.R. and D.J. St. Aubin. 1982. Study of the Effects of Oil on Cetaceans. Final report. Washington, DC: USDOI, BLM, 274 pp.

Gerlach, S.C. and Hall, E.S. Jr. 1988. The Later Prehistory of Northern Alaska: The View From Tukuto Lake. *In:* The Late Prehistoric Development of Alaska's Native People, R.D. Shaw, R.K. Harritt, and D.E. Dumond, eds. Monograph Series No. 4. Aurora, AK: Anthropological Association.

Gersper, P.L., V. Alexander, S.A. Barkley, R.J. Barsdate, and P.S. Flint. 1980. The Soils and Their Nutrients. *In:* An Arctic Ecosystem: The Coastal Tundra at Barrow, Alaska, J. Brown, P.C. Miller, L.L. Tieszen, and F.L. Bunnell, eds. US/IBP Synthesis Series US 12. Stroudsburg, PA: Dowden, Hutchinson, and Ross, pp. pp. 219-80 571 pp.

Gilliam, J.K. and P.C. Lent. 1982. Proceedings of the National Petroleum Reserve in Alaska Caribou/Waterbird Impact Analysis Workshop May 11-13, 1982, Anchorage, AK. Anchorage, AK: USDOI, BLM, Alaska State Office, 61 pp.

Grantz, A. and S.D. May. 1982. Rifting History and Structural Development of the Continental Margin North of Alaska. *In:* *Studies in Continental Margin Geology*, J.S. Watkins and C.L. Drake, eds. Memoir 34. American Association of Petroleum Geologists, pp. 77-100.

Gregor, D.J. and W.D. Gummer. 1989. Evidence of Atmospheric Transport and Deposition of Organochlorine Pesticides and Polychlorinated Biphenyls in Canadian Arctic Snow. *Environmental Science and Technology* 23(5): 561-565.

Gress, F., R.W. Risebrough, D.W. Anderson, L.F. Kiff, and J.R. Jehl Jr. 1973. Reproductive Failures of Double-Crested Cormorants in Southern California and Baja California. *Wilson Bulletin* 85: 197-208.

Gryc, G., ed. 1988. Geology and Exploration of the National Petroleum Reserve in Alaska, 1974-1982. USGS Professional Paper 1399. U.S. Geological Survey, 940 pp.

Guthrie, D.R. and S. Stoker. 1990. Paleoecological Significance of Mummified Remains of Pleistocene Horses From the North Slope of the Brooks Range, Alaska. *Arctic* 43: 267-274.

Habitat North, Inc. 1979. Socioeconomic Impacts of Selected Foreign OCS Developments. Technical Report No. 28. Anchorage, AK: USDOI, BLM, Alaska OCS Office, Socioeconomic Studies, 314 pp.

Haldorson, L. and P. Craig. 1984. Life History and Ecology of a Pacific Arctic Population of Rainbow Smelt in Coastal Waters of the Beaufort Sea. *Transactions of the American Fisheries Society* 113: 33-38.

Hall, E.S. Jr. and L. Fullerton, eds. 1988. Excavation of a Prehistoric Catastrophe: A Preserved Household From the Utqiagvik Village, Barrow, Alaska. Barrow, AK: NSB Commission on Inupiat History, Language, and Culture.

Hamilton, C.I., S.J. Starr, and L.L. Trasky. 1979. Recommendations for Minimizing the Impacts of Hydrocarbon Development on the Fish, Wildlife, and Aquatic Plant Resources of Lower Cook Inlet Vols. I and II. Anchorage, AK: State of Alaska, Dept. of Fish and Game, Marine and Coastal Habitat Management, 420 pp.

Hamilton, T.D. and G. Ashley. 1993. A Late Quaternary Environmental Record From Northwestern Alaska. *Geological Society of America Bulletin* 105: 583-602.

Hammill, M.O. and T.G. Smith. 1991. The Role of Predation in the Ecology of the *Ringed* Seal in Barrow Strait, Northwest Territories, Canada. *Marine Mammal Science* 7: 123-135.

Hansen D.J., Author. The Possible Contribution of the Shrimp-Trawl Fishery and Decline in Capelin Abundance to the Decline of Harbor Seal, Phoca Vitulina Richardsi, and the Northern Sea Lion, Eumetopias Jubatus, in the Western Gulf of Alaska. in press. International Symposium on the Role of Forage Fishes in Marine Ecosystems. November 13-16, 1996, Anchorage, AK. 14th Lowell Wakefield Fisheries Symposium. Fairbanks, AK: Alaska Sea Grant College Program University of Alaska.

Hansen, D.J. 1985. The Potential Effects of Oil Spills and Other Chemical Pollutants on Marine Mammals Occurring in Alaskan Waters. OCS Report MMS 85-0031. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 21 pp.

Hansen, D.J. 1992. Potential Effects of Oil Spills on Marine Mammals That Occur in Alaskan Waters. OCS Report MMS 92-0012. Anchorage, AK: USDOI, MMS Alaska OCS Region, 25pp.

Harcharek, R.C. 1992. North Slope Borough 1992 Economic Profile. Vol. VI. Barrow, AK: North Slope Borough, Department of Planning & Community Services.

Harcharek, R.C., Ph.D. 1995. North Slope Borough 1993/94 Economic Profile and Census Report Vol. VII. Barrow, Alaska: North Slope Borough, Department of Planning and Community Services.

Harding, L.E. 1976. Den-Site Characteristics of Arctic Coastal Grizzly Bears (*Ursus Arctos*) on Richards Island, Northwest Territories, Canada. *Canadian Journal Zoology* 54: 1357-1363.

Harding L. and J.A. Nagy. 1980. Responses of Grizzly Bears to Hydrocarbon Exploration on Richards Island, Northwest Territories, Canada. *In*: Fourth International Conference Bears Resource and Management. Bears-Their Biology and Management 4. 4pp. 277-80.

Harfenist, A., A.P. Gilman, and K.L. Maus. 1990. The Effects of Exposure of Incubating Adult and Young Herring Gulls to a Simulated No. 2 Fuel Oil Slick. *Archives of Environmental Contamination and Toxicology* 19: 902-906.

Harvey, S., J.G. Phillips, and P.J. Sharp. 1982. Reproductive Performance and Endocrine Responses to Ingested North Sea Oil. *In*: Aspects of Avian Endocrinology: Practical and Theoretical Implications. C.G. Scanes, A. Epple, and M.H. Stetson, eds. Graduate Studies (Texas Tech University) 26. Lubbock, TX: Texas Technical University, pp. 379-395.

Haynes, T. and S. Pedersen. 1989. Development and Subsistence: Life After Oil. Alaska Fish and Game 21(6): 24-27, November-December 1989.

Hays, W.L. 1973. *Statistics for the Social Sciences*. New York: Holt, Rinehart and Winston.

Heard, D.C. and T.M. Williams. 1991. Wolf Den Distribution on Migratory Barren-Ground Caribou Ranges in th. Northwest Territories (Abstract). *In*: Proceedings of the Fourth North American Caribou Workshop, C. Butler and S.P. Mahoney, eds. 1991, St John's Newfoundland pp. 249-50.

Heinrich, A.C. 1963. Eskimo Type Kinship and Eskimo Kinship. Unpublished Ph.D. Dissertation. Ann Arbor, MI: University of Washington, University Microfilms.

Hemming, C.R. 1996. Fish Surveys of Selected Coastal Streams Sagavanirktok River to Bullen Point, 1995. Technical Report No. 96-3. Juneau, AK: State of Alaska, Dept. of Fish and Game, Habitat and Restoration Div., 28 pp.

Hemming, C.R. 1993. Tundra Stream Fish Habitat Investigations in the North Slope Oilfields. Technical Report No. 93-1. Juneau, AK: State of Alaska, Dept. of Fish and Game, Habitat and Restoration Div., 64 pp.

Hemming, C.R., P.K. Weber, and J.F. Winters. 1989. Limnological and Fisheries Investigations of Flooded North Slope Gravel Mine Sites, 1988. Technical Report No. 89-1. Juneau, AK: State of Alaska, Dept. of Fish and Game, Habitat Div., 60 pp.

Hemming, J.E. 1971. The Distribution Movement Patterns of Caribou in Alaska. Technical Bulletin No. 1. ADF&G Federal Aid wildlife Restoration Project W-17-R. Juneau, AK: State of Alaska, Dept. of Fish and Game.

Henshaw, J. 1968. The Activities of the Wintering Caribou in Northwestern Alaska in Relation to Weather and Snow Conditions. *International Journal of Biometeorology* 12: 18-24.

Hepa, T. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Barrow, Alaska, Monday, March 17, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM, 25 pp.

Hepa, T. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Nuiqsut, Alaska, Thursday, April 10, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM, 28 pp.

Hershey, A.E., W.B. Bowden, L.A. Deegan, J.E. Hobbie, B.J. Peterson, G.W. Kipphut, G.W. Kling, M.A. Lock, R.W. Merritt, M.C. Miller, J.R. Vestal, and J.A. Schuldt. 1995. The Kuparuk River: A Long-Term Study of Biological and Chemical Processes in an Arctic River. Freshwaters of Alaska: Ecological Synthesis. A.M. Milner and M.W. Oswood, eds. New York, NY: Springer-Verlag, pp. pp. 107-29.

Hill, E.L. 1984. Behavior Reaction of Caribou to the Upper Salmon Hydroelectric Development in Newfoundland. 2nd North American Caribou Workshop. Meredith T., chairman. 10-17 to 10-20. Montreal Quebec, Canada: McGill University. Montreal: McGill University., Page 7.

Hill, P.S., D.P. DeMaster, and R.J. Small. 1996. Draft Alaska Marine Mammal Stock Assessments 1996. NOAA Technical Memorandum NMFS-AFSC. Seattle, WA: USDOC, NOAA, NMFS, Alaska Fisheries Science Center, 93 pp.

Hinzman, L.D., D.L. Kane, and K.R. Everett. 1993. Hillslope Hydrology in an Arctic Setting. *In*: Proceedings of the Sixth International Conference on Permafrost, Beijing, China pp. 267-271.

Hoffman, D., D. Libby, and G. Spearman. 1988. Nuiqsut: A Study of Land Use Values Through Time. Occasional Paper No. 12. Fairbanks, AK: University of Alaska, Fairbanks. NPR-A Study for the North Slope Borough.

Holmes, W.N. and K.P. Cavanaugh. 1990. Some Evidence for an Effect of Ingested Petroleum on the Fertility of Mallard Drake (*Anas Platyrhnchos*). *Archives of Environmental Contamination and Toxicology* 19: 898-901.

Holmes, W.N. and J. Cronshaw. 1977. Biological Effects of Petroleum on Marine Birds. *In*: Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. D.C. Malins, ed Vol. II: Biological Effects. New York: Academic Press, Inc., pp. 359-398.

Horejsi, B. 1981. Behavioral Response of Barren-Ground Caribou to a Moving Vehicle. *Arctic* 34(2): 180-185.

Horner, R.A. 1969. Phytoplankton Studies in the Coastal Waters Near Barrow, Alaska. Ph.D. Dissertation. Seattle, WA: University of Washington, 261 pp.

Hubbard, R.J., S.P. Edrich, and R.P. Rattey. 1987. Geological Evolution and Hydrocarbon Habitat of the "Arctic Alaska Microplate". *Marine and Petroleum Geology* 4: 2-34.

Huffman, A.C. Jr., T.S. Ahlbrandt, and S. Bartsch-Winkler. 1988. Sedimentology of the Nanushuk Group, North Slope. *In*: *Geology and Exploration of the National Petroleum Reserve in Alaska, 1974-1982*. G. Gryc, ed. USGS Professional Paper 1399. U.S. Geological Survey., pp. 281-298.

Hugo, B. 1990. Testimony at the Public Hearing on the Beaufort Sea Sale 124 DEIS. Apr. 17, 1990, Barrow, Ak. Anchorage, Ak.: USDOI, MMS, Alaska OCS Region, 108 pp.

Human Relations Area Files, Inc. 1992. Social Indicators Study of Alaskan Coastal Villages, I. Key Informant Summaries. Vol. 1: Schedule A Regions (North Slope, NANA, Calista, Aleutian-Pribilof). J.G. Jorgensen, Principal Investigator. OCS Study MMS 92-0031. Technical Report No. 151. Anchorage, Ak.: USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program.

Human Relations Area Files, Inc. 1994. Social Indicators Study of Alaskan Coastal Villages VI. Analysis of the *Exxon Valdez* Spill Area. OCS Study, MMS 94-0064. Technical Report No. 157. Anchorage, Ak.: USDOI, MMS, Alaska OCS Region, Environmental Studies Program.

Impact Assessment, Inc. 1990. Northern Institutional Profile Analysis: Beaufort Sea. OCS Study MMS 90-0023. Technical Report No. 42. Anchorage, Ak.: USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program, 670 pp.

Impact Assessment, Inc. 1990. Northern Institutional Profile Analysis: Chukchi Sea. OCS Study MMS 90-0022. Final Report. Technical Report No. 141. Anchorage, Ak.: USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program, 750 pp.

Impact Assessment, Inc. 1990d. Economic, Social, and Psychological Impact Assessment of the Exxon Valdez Oil Spill. Final Report. Anchorage, AK: Impact Assessment, Inc.

Industry Task Group. 1983. Oil Spill Response in the Arctic, Part 2: Field Demonstrations in Broken Ice. Anchorage, AK: Sohio Alaska Petroleum Company, Exxon Company, U.S.A., and Amoco Production Company, 108 pp.

Inkeles, A. 1973. Making Men Modern: On the Causes and Consequences of Individual Change in Six Developing Countries. *In*: Social Change, A. Etzioni and E. Etzioni-Halevy, eds. New York: Basic Books, pp. 342-61.

International Pacific Halibut Commission. 1993. Annual Report, 1992. Seattle, WA: International Pacific Halibut Commission.

Irving, W.N. 1964. Punyik Point and the Arctic Small Tool Tradition. Ph.D. Dissertation. University of Wisconsin.

Itta, N. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Barrow, Alaska, Monday, March 17, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM, 25 pp.

Jackson, H.R. and K. Gunnarsson. 1990. Reconstructions of the Arctic: Mesozoic to Present. *Tectophysics* 172: 303-322.

Jeffrey, M. 1979 (Testimony). Public Hearing on the BF Oil and Gas Lease Sale, Kaktovik, Alaska, May 15, 1979. Minerals Management Service. Anchorage, AK: USDOI, Minerals Management Service, 92 pp. + 33 p. and 26 p. attachments.

Jingfors K., P. Lassen, authors. 1984. Muskox Responses to a Seismic Test Operation: Preliminary Observations. in: First International Muskox Symposium Biol. Pap. UAF Spec. Rept. No. 4, R.G.W. a S.K. D.R. Klein, editors, Fairbanks: University of AK, Fairbanks UAF, page 127, 218 pp.

Jingfors K.T. 1982. Seasonal Activity Budgets and Movements of a Reintroduced Alaskan Muskox Herd. *Journal Wildlife Management* 46(2): 344-350.

Johnson, C.B., Jorgenson M.T., Burgess R.M., Lawhead B.E., Rose J.R., and Stickney, A.A. (Alaska Biological Research, Inc.). Wildlife Studies on the Colville River Delta, Alaska, 1995. Fairbanks, AK: ABR, Inc., 1996. Preliminary Draft Report Prepared for ARCO Alaska, Inc. and Kuukpik Unit Owners. 86 pp. + Tables, Figures, and Appendices. Note: Distribution, Abundance, Habitat Use (Extensive) of Waterfowl, Caribou, Fox.; Lowry Copy.

Johnson, C.B., M.T. Jorgenson, R.M. Burgess, B.E. Lawhead, J.R. Rose, and A.A. Stickney. 1996. Wildlife Studies on the Colville River Delta, 1995. Fourth Annual Report. Anchorage, AK: ARCO Alaska, Inc. and the Kuparuk Unit Owners, 154 pp.

Johnson, D.R. and M.C. Todd. 1977. Summer Use of a Highway Crossing by Mountain Caribou. *The Canadian Field-Naturalist* 91(3): 312-314.

Johnson, F.G. 1977. Sublethal Biological Effects of Petroleum Hydrocarbon Exposures: Bacteria, Algae, and Invertebrates. *In*: Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. D.C. Malins, ed. Vol. II, Biological Effects. New York, NY: Academic Press, Inc., pp. 271-318.

Johnson, S.R. 1979. Fall Observations of Westward Migrating White Whales (*Delphinapterus Leucas*) Along the Central Alaskan Beaufort Sea Coast. *Arctic* 32(3): 275-276.

Johnson, S.R. and D.R. Herter. 1989. *The Birds of the Beaufort Sea*. Anchorage, AK: BP Exploration (Alaska), Inc. Prepared by LGL Alaska Research Associates, Inc.

Johnson, S.R. and J.W. Richardson, eds. 1981. Birds. Part 3. *In*: Beaufort Sea Barrier Island-Lagoon Ecological Process Studies: Final Report, Simpson Lagoon. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Vol. 7 Biological Studies(Feb. 1981). Boulder, CO: USDOC, NOAA, and USDOI, BLM, pp. 109-383.

Johnson, S.R. and Herter, D.R. The Birds of the Beaufort Sea. Anchorage, AK: BP Exploration Alaska Inc., 1989. Note: 372 pp.

Johnson, M.J., D.G. Howell, and K.J. Bird. 1993. Thermal Maturity Patterns in Alaska: Implications for Tectonic Evolution and Hydrocarbon Potential. *American Association of Petroleum Geologists Bulletin* 77(11): 1,874-1,903.

Johnston, D. 1997. As cited in: Alpine Development Project Environmental Evaluation Document, ARCO Alaska Inc. Anchorage, AK: ARCO Alaska, Inc., Chapter 4.6.

Jonkel, C., G. Kolenosky, R. Robertson, and R. Russell. 1972. Further Notes on Polar Bear Denning Habitats. Panel 3, Polar Bear Studies. *In*: Bears, Their Biology and Magament: A Selection of Papers and Discussion From the Second International Conference on Bear Research and Management. S. Herrero, ed. Nov. 6-9, 1970, Calgary, Alberta, Canada: University of Calgary. Morges, Switzerland: IUCN, pp. 142-58.

Jorgenson, J.C., P.E. Joria, T.R. McCabe, B.E. Reitz, M.K. Raynolds, M. Emers, and M.A. Williams. 1994. User's Guide for the Land-Cover Map of the Coastal Plain of the Arctic National Wildlife Refuge. Anchorage, AK: USDOI, FWS, 46 pp.

Jorgenson, J.C. In press. Tundra Disturbance and Recovery Nine Years After Winter Seismic Exploration in Northern Alaska. Arctic and Alpine Research.

663

Jorgenson, J. and P. Martin. 1997. Effects of Winter Seismic Exploration on Tundra Vegetation and Soils. *In:* NPR-A Symposium, Science, Traditional Knowledge, and the Resources of the Northeastern Planning Area of the National Petroleum Reserve in Alaska. Apr. 16-18, 1997, Anchorage, AK. OCS Study, MMS 97-0013. Anchorage, AK: USDOI, MMS, Alaska OCS Region, and BLM. 99 pp. plus attachments.

Jorgenson, M.T. 1977. Effects of Petroleum Spills on Tundra Ecosystems. *In:* Proceedings: Science, Traditional Knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve in Alaska. Apr. 16-18, 1997, Anchorage, AK. OCS Study, MMS 97-0013. Anchorage, AK: USDOI, MMS, and BLM. 99 pp. plus attachments.

Joyce, M. 1997. Notes Taken in May, 1997 by Dick Roberts, USDOI, MMS Alaska OCS Region, From a Talk Given by Mike, Joyce, ARCO Alaska at the Shorebird/Caribou Workshop in Fairbanks, Alaska. Subject: The Area the Largest Spill Covered on the Ground.

Kachadoorian, R. and E.C. Frederick. 1988. Engineering Geology Studies in the National Petroleum Reserve in Alaska. *In: Geology and Exploration of the National Petroleum Reserve in Alaska, 1974-1982*, G. Gryc, ed. USGS Professional Paper 1399. U.S. Geological Survey, pp. 899-922.

Kachadoorian, R. and F. Crory. 1988. Engineering Geology Studies in the National Petroleum Reserve in Alaska. *In:* Geology and Exploration of the National Petroleum Reserve in Alaska, 1974 to 1982., G. Gryc, ed. U.S. Geological Survey Professional Paper 1399. Anchorage, AK: U.S. Geological Survey.

Kagak, I. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Atqasuk, Alaska. Tuesday, March 18, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM, 17 pp.

Kaleak, J. 1996. History of Subsistence Whaling in Kaktovik. *In:* Proceedings of the 1995 Arctic Synthesis Meeting, Oct. 23-25, 1995, Anchorage, AK. OCS Study, MMS 95-0065. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Kane, D.L., L.D. Hinzman, M.K. Woo, and K.R. Everett. 1992. Arctic Hydrology and Climate Change. *In:* Arctic Ecosystems in a Changing World. Academic Press. pp. pp. 35-57.

Kiev, A. 1964. Investigations for the Future. *In:* Magic, Faith and Healing, Studies in Primitive Psychiatry Today. New York: Free Press of Glencoe. pp. 454-64.

King, R.J., and Brackney, A.W., U.S. Fish and Wildlife Service, Migratory Bird Management. Aerial Breeding Pair Surveys of the Arctic Coastal Plain of Alaska-1996. Fairbanks, AK: U.S. Fish and Wildlife Service, 1997, 12 pp.

Kelly, B.P. 1988. *In:* Selected Marine Mammals of Alaska: Species Accounts With Research and Management Recommendations. J.W. Lentfer, ed. Washington, DC: Marine Mammal Commission, pp. 57-77.

Kempka, R.G., R.D. Macleod, F.A. Reid, J. Payne, D.A. Yokel, and G. Balogh. 1995. National Petroleum Reserve, Alaska Landcover Inventory: Exploring Arctic Coastal Plain Using Remote Sensing. *In:* Ninth Annual Symposium on Geographic Information Systems. August 1995, Vancouver, B.C., Canada. Vancouver, B.C., Canada: GIS World, Inc. pp. 788-96.

Kertell, K. 1991. Disappearance of the Steller's Eider From the Yukon-Kuskokwim Delta, Alaska. *Arctic* 44(3): 177-187.

Kertell, K. 1996. Response of Pacific Loons (*Gavia Pacifica*) to Impoundments at Prudhoe Bay, Alaska. *Arctic* 49(4): 356-366.

Kevin Waring & Associates. 1989. A Demographic and Employment Analysis of Selected Alaska Rural Communities, Volume II (Northern Communities). OCS Study, MMS 89-0083. Technical Report No. 137. 3 Vols. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program. 133 pp.

Kinder, T.H. and J.D. Schumacher. 1981. Hydrographic Structure Over the Continental Shelf of the Southeastern Bering Sea. *In:* The Eastern Bering Sea Shelf: Oceanography and Resources Vol. 1. Juneau, AK: USDOC, NOAA, OMPA, and USDOI, BLM. pp. 31-52. Distributed by the University of Washington Press, Seattle, Wash.

Kineman, J.J., R. Elmgren, and S. Hansson, eds. 1980. The *Tsesis* Oil Spill: Report of the First Year Scientific Study (October 26, 1977 to December 1978). Boulder, CO: USDOC, NOAA, OMPA, 296 pp.

Klein D.R., author. 1980. Reaction of Caribou and Reindeer to Obstructions - A Reassessment. *In:* Second International Reindeer/Caribou Symposium, E. Reimers, E. Gaare & S. Skjenneberg, editor. 1980, Roros, Norway. Roros, Norway.

Kolenosky, G.B. and J.P. Prevett. 1983. Productivity and Maternity Denning of Polar Bears in Ontario. *In:* Bears--Their Biology and Management. Fifth International Conference on Bear Research and Management, E.C. Meslow, ed. Feb. 1980, Madison, Wis. Morges, Switzerland: International Association for Bear Research and Management. pp. 238-45.

Kornbrath, R.W. 1994. Analysis of Historical Lease Sale and Exploration Data for Alaska. Unpublished internal report and data file. Anchorage, AK: State of Alaska, DNR, Div. of Oil and Gas. 48 pp.

Kornbrath, R.W., M.D. Myers, D.L. Krouskop, J.F. Meyer, J.A. Houle, T.J. Ryherd, and K.N. Richter. 1997. Petroleum Potential of the Eastern National Petroleum Reserve-Alaska. Nonnormalized report. Anchorage, AK: State of Alaska, DNR, Div. of Oil and Gas. 37 pp.

Koth, V. and E. Vauk-Hentzelt. 1988. Influence of Plumage and Stomach Oiling on Body and Organ Growth in Young Kittiwakes. *Marine Pollution Bulletin* 19(2): 71-73.

Kraus, R.F. and P.A. Buffler. 1979. Sociocultural Stresses and the American Native in Alaska: An Analysis of Changing Patterns of Psychiatric Illness and Alcohol Abuse Among Alaska Natives. *Culture, Medicine and Psychiatry* 3(2):111-151.

Kruse, J. 1982. Subsistence and the North Slope Inupiat: The Effects of Energy Development. Monograph No. 4. Anchorage, AK: University of Alaska, Institute of Social and Economic Research.

Kruse, J.A., M. Baring-Gould, W. Schneider, J. Gross, G. Knapp, and G. Sherrod. 1983. A Description of the Socioeconomics of the North Slope Borough. Technical Report No. 85. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program. 292 pp.

Kunz, M.L. 1996. From the Arctic to the High Plains: Climatic and Environmental Factors Influencing the Southward Movement of the Earliest North Americans. *In:* Abstracts of the 54th Annual Plains Anthropological Conference, Iowa City, Iowa.

Kunz, M.L. and R. Reanier. 1995. The Mesa Site: A Paleoindian Hunting Lookout in Arctic Alaska. *Arctic Anthropology* 32(1):5-30.

Kunz, M.L. and R. Reanier. 1994. Paleoindians in Beringia: Evidence From Arctic Alaska. *Science* 263:660-662.

Kuropat, P. and J. Bryant. 1980. Foraging Behavior of Cow Caribou on the Utukok Calving Grounds in Northwestern Alaska. AlnA Proceedings of the Second Reindeer/Caribou Symposium, E. Reimers, E. Gaare, and S. Skjenneberg, eds. September 17-21, 1979, Roros, Norway. Trondheim, Norway: Direktoratet for vilt og ferskvannsfisk.

Lampe, L. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Nuiqsut, Alaska, Thursday, April 10, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM. 28 pp.

Lampe, L., Jr. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Nuiqsut, Alaska, Thursday, April 10, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM. 28 pp.

Langdon, S. 1996. An Overview of North Slope Society: Past and Future. *In:* Proceedings of the 1995 Synthesis Meeting, Oct. 23-25, 1995, Anchorage, Ak. OCS Study MMS 95-0065. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Lantis, M. 1959. Alaskan Eskimo Cultural Values. *Polar Notes* 1:35-48.

Lantis, M. 1973. The Current Nativistic Movement in Alaska. *In:* Circumpolar Problems: Habitat, Economy, and Social Relationships in the Arctic, G. Berg, ed. Elmsford, NY: Pergamon Press.

Larned, W.W. and G.R. Balogh. U.S. Fish and Wildlife Service, Migratory Bird Management Project. Eider Breeding Population Survey, Alaska Arctic Coastal Plain, 1993. Anchorage, AK: USFWS. 1994. Progress Report Prepared for USFWS, Migratory Bird Management Project. 15 pp.

Larned, W.W., G.R. Balogh, R.A. Stehn, and W.I. Butler. 1993. The Status of Eider Breeding Populations in Alaska, 1992. Anchorage, AK: USDOI, FWS. 55 pp. Unpublished report.

Larned, W.W. and G.R. Balogh. 1994. Eider Breeding Population Survey, Alaska Arctic Coastal Plain, 1993. Progress Report. Anchorage, AK: USDOI, FWS. 18 pp.

Lawhead, B.E. and D.A. Flint. 1993. Caribou Movements in the Vicinity of the Planned Drill Site 3-T Facilities, Kuparuk Oilfield, Alaska, 1991-1992. Progress Report. Anchorage, AK: ARCO Alaska, INC., and the Kuparuk River Unit. 62pp.

Lavrakas, D. 1996. Meeting Yields Northstar Questions. *Arctic Sounder*, pp. 1, 5. Aug. 1, 1996.

Leavitt, J. 1980. Leavitt vs United States: NSB Residents Sue for Native Allotments Inside NPR-A. Arctic Coastal Zone Management Newsletter. November 1980.

Leavitt, D. 1990. Testimony at the Public Hearing on the Beaufort Sea Sale 124 DEIS, Apr. 17, 1990, Barrow, Ak. Anchorage, AK: USDOI, MMS, Alaska OCS Region. 108 pp.

Lefevre, J. 1987. Telephone Conversation on Aug. 11, 1987, to Jessica Lefevre, AEWC Legal Counsel, from Helen Armstrong, Anthropologist, Alaska OCS Region, MMS, USDOI; Subject: Native Bowhead Whale-Hunt Regulations.

Lent, P.C. 1966. The Caribou of Northwestern Alaska. *In:* Environment of the Cape Thompson Region, Alaska, Chapter 19, N.J. Wilimovsky and J. Wolfe, eds. Oak Ridge, TN: USDOI, Atomic Energy Commission, Div. of Technical Information, pp. 481-516.

Lent, P.C. 1970. Muskox Maternal Behavior - a Preliminary Description. *American Zoologist* 10(4): page 35.

Lent, P.C. 1980. Synoptic Snowmelt Patterns in Arctic Alaska in Relation to Caribou Habitat Use. *In:* Proceedings of the Second International Reindeer/Caribou Symposium, E. Reimers, E. Gaare, and S. Skjenneberg, eds. Sept. 17-21, 1979, Roros, Norway. Trondheim, Norway: Direktoratet for vilt og ferskvannsfisk.

Lentfer, J. 1972. Polar Bears - Sea Ice Relationships. Bears - Their Biology and Management. *In:* Bears - Their Biology and Management. A Selection of Papers From the Second International Conference on Bear Research and Management, S. Herrero, ed. Nov. 6-9, 1970, Calgary, Alberta, Canada. IUCN Publications, New Series, Vol. 23. Morges, Switzerland: International Union for Conservation of Nature and Natural Resources.

Lerand, M. 1973. Beaufort Sea. *In*: *The Future Petroleum Provinces of Canada-Their Geology and Potential*, R.G. McCrossam, ed. Memoir 1. Canadian Society of Petroleum Geologists, pp. 315-386.

Leslie, L.D. 1986. Alaska Climate Summaries. Technical Note no. 3. Anchorage, AK: AEIDC.

Lewis, J.P. and R. Sellers. 1991. Assessment of the *Exxon Valdez* Oil Spill on Brown Bears on the Alaska Peninsula. *Exxon Valdez* Oil Spill Natural Resource Damage Assessment. NRDA Terrestrial Mammal Study Number 4, Unpublished Final Report. Anchorage, AK: State of Alaska, ADF&G., pp.

Libbey, D. 1988-1989. The 1981 Excavations at the Utqiagvik Archaeological Site, Barrow, Alaska, Volume I. *In*: Utqiagvik Excavations, Hall, H.S. Jr., ed. Barrow, AK: North Slope Borough Commission on Inupiat History, Language, and Culture.

Lindsey, K.D. 1986. Paleontological Inventory and Assessment of Public Lands Administered by Bureau of Land Magament, State of Alaska. Anchorage, AK: USDOI, BLM, pp. 121-187. Contract No. AK 950CT5-15.

Lipkin, R. 1977. Known Rare or Sensitive Plant Species Within the Planning Area. *In*: The NPR-A Symposium: Science, Traditional Knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve in Alaska. Apr. 16-18, 1997, Anchorage, AK. Anchorage, AK: USDOI, BLM, and MMS.

Loughlin T.R. 1989. Effects of Fisheries on the Abundance of Three Pinniped Species in Alaska. in: 8th Biennial Conference on the Biology of Marine Mammals, Society for Marine Mammalogy, compiler. December 7-11, 1989, Pacific Grove, CA. Pacific Grove, CA: Society for Marine Mammalogy., 81pp.

Lowenstein, T. 1981. Some Aspects of Sea Ice Subsistence Hunting in Point Hope, Alaska. Barrow, AK: North Slope Borough, Coastal Zone Management Plan, 83 pp.

Luton, H.H. 1985. Effects of Renewable Resource Harvest Disruptions on Socioeconomic and Sociocultural Systems: Wainwright, Alaska. Technical Report No. 91. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program, 603 pp.

Machida, S. 1995. Subunit 26A Teshekpuk Lake Herd. *In*: Caribou, M.V. Hicks, ed. Federal Aid in Wildlife Restoration Annual Performance Report of Survey-Inventory Activities, 1 July 1994- 30 June 1995 Grant w-24-3, study 3.0. Federal Aid in Wildlife Restoration Annual Performance Report of Survey-Inventory Activities. Juneau, AK: State of Alaska, Dept. of Fish and Game, Div. of Wildlife Conservation, 28 pp.

Machida S., author. 1995. Western Alaska Wolf Population Management. in: Wolf, M.V. Hicks, editor. Grant W-24-3, Study 14.0. ADF&G Division Wildlife Conservation, Federal Aid in Wildlife Restoration Annual Performance Report of Survey-Inventory Activities. Juneau, AK: ADF&G, 26pp.

Machida, S. 1994. Western Arctic Herd and Teshekpuk Lake Caribou Herd. *In*: Caribou, M.V. Hicks, ed. Federal Aid in Wildlife Restoration Annual Performance Report of Survey-Inventory Activities. Grant w-24-2, study 3.0. Juneau, AK: State of Alaska, Dept. of Fish and Game, Div. Wildlife Conservation, 26 pp.

Mager, A. 1984. Status Review: Marine Turtles Under Jurisdiction of the Endangered Species Act of 1973. 609-C-1. St. Petersburg, Fl: USDOC, NOAA, NMFS, 64 pp.

Magoon, L.B. and G.E. Claypool. 1988. Geochemistry of Oil Occurrences, National Petroleum Reserve in Alaska. *In*: Geology and Exploration of the National Petroleum Reserve in Alaska, 1974 to 1982. G. Gryc, Ed. U. S. Geological Survey Professional Paper1399. Washington, DC: United States, DOI, GS, pp. 519-549.

Markon, C. 1986. Arctic National Wildlife Refuge Land-Cover Mapping Project User's Guide. Anchorage, AK: U.S. Geological Survey, 14 pp. Unpublished report available from USGS/EROS Field Station, 4230 University Dr., Anchorage, AK 99508.

Markon, C.J. and Derksen, D.V. Identification of Tundra Land Cover near Teshekpuk Lake, Alaska Using SPOT Satelite Data. Arctic. 1994; 47(3):222-231. Note: Arctic Institute of North America.

Markon, C.J. and D.V. Derksen. 1994. Identification of Tundra Land Cover Near Teshekpuk Lake, Alaska, Using SPOT Satellite Data. *Arctic* 47(222). 231.

Martin, D.J. 1989. Effects of Petroleum Contaminated Waterways on Migratory Behavior of Adult Pink Salmon. *In*: Proceedings of the Gulf of Alaska, Cook Inlet, and North Aleutian Basin Information Update Meeting, L.E. Jarvela and Thorsteinson L.K., eds. Feb. 7-8, 1989, Anchorage, AK. OCS Study, MMS 89-0041. Anchorage, AK: USDOC, NOAA, NOS, and USDOI, MMS, Alaska OCS Region, pp. 35-38.

Martin, G.C. 1921. Preliminary Report on Petroleum in Alaska. Washington, DC: U.S. Geological Survey.

McCarthy T.M. R.J. Seavoy, authors. 1994. Reducing Nonsport Losses Attributable to Food Conditioning: Human and Bear Modification in An Urban Environment. in: Ninth International Conference on Bear Research and Management Bears-Their Biology and Management, J.J. Claar, P. Schullery, editors. February 1992, Missoula, Montana. 9(1): International Association for Bear Research and Management, 75-84, 500pp.

McCown, B.H., J. Brown, and R.J. Barsdate. 1973. Natural Oil Seeps at Cape Simpson, Alaska: Localized Influences on Terrestrial Habitat. *In*: Proceedings of the Symposium on the Impact of Oil Resource Development on Northern Plant Communities (23rd AAAS Alaska Science Conference). B.H. McCown and D.R. Simpson, Coordinators. August 17, 1972, Fairbanks, AK. Occasional Publication on Northern Life 1. Fairbanks, AK: University of Alaska, Fairbanks, Institute of Arctic Biology, pp. 86-90.

McCrea, M. 1983. Federal and State Coastal Management Programs. Reference Paper 83-1. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 24 pp. and appendices.

McKendrick, J.D. 1977. Recovery and Rehabilitation of Disturbed Wetland Sites. *In*: Proceedings: Science, Traditional Knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve in Alaska. Apr. 16-18, 1977, Anchorage, AK. OCS Study, MMS 97-0013. Anchorage, AK: USDOI, MMS, and BLM. 99 pp. plus attachments.

McKendrick, J. and W. Mitchell. 1978. Fertilizing and Seeding Oil-Damaged Arctic Tundra to Effect Vegetation Recovery, Prudhoe Bay, Alaska. *Arctic* 31(3): 296-304.

McLellan B. D.M. Shackleton. 1989. Immediate Reactions of Grizzly Bears to Human Activities. *Wildlife Society Bulletin* 17: 269-274.

McLellan B.N. 1990. Relationships Between Human Industrial Activity and Grizzly Bears. *In*: Bears-Their Biology and Management. L.M. Darling and Archibald, eds. February 1989, Victoria, B.C. Eighth International Conference on Bear Research and Management. Vancouver, B.C., Canada: International Association for Bear Research and Management, pp. 57-64.

Meares, D. 1997. Telephone Conversation Dated May 7, 1977, Between D. Meares, USDOI, BLM, Fairbanks, and John Tremont, Geographer, USDOI MMS, Alaska OCS Region. Subject: Inigok Airstrip.

Mellor, J.C. 1987. A Statistical Analysis and Summary of Radar-Interpreted Arctic Lake Depths. BLM-Alaska Technical Report 11. Anchorage, AK: USDOI, BLM, 33 pp.

Middaugh, J.P., J. Miller, C.E. Dunaway, S.A. Jenkerson, T. Kelly, D. Ingle, D. Perham, D. Fridley, W.G. Hlady, and V. Hendrickson. 1991. Causes of Death in Alaska 1950, 1980-1989: An Analysis of the Causes of Death, Years of Potential Life Lost, and Life Expectancy. Anchorage, AK: State of Alaska, Dept. of Health and Social Services, Div. of Public Health, 224 pp.

Milan, F.A. 1964. The Acculturation of the Contemporary Eskimo of Wainwright, Alaska. *Anthropological Papers of the University of Alaska* 11(2).

Miller, D.R., author. 1974. Seasonal Changes in the Feeding Behavior of the Barren-Ground Caribou on the Taiga Winter Range. *In*: The Behavior of Ungulates and Its Relationship to Management. V. Geist and F. Walters, eds. 1971, Alberta, Canada. IUCN Pub New Series No. 24. Calgary, Alberta, Canada: University of Calgary.

Miller, F.L., A. Gunn, and E. Broughton. 1985. Surplus Killing As Exemplified by Wolf Predation on Newborn Caribou. *Canadian Journal Zoology* 63(2): 295-300.

Miller, G.W., R.E. Elliott, and W.J. Richardson. 1996. Marine Mammal Distribution, Numbers and Movements. *In*: Northstar Marine Mammal Monitoring Program, 1995: Baseline Surveys and Retrospective Analyses of Marine Mammal and Ambient Noise Data From the Central Alaskan Beaufort Sea. LGL Report TA 2101-2. King City, Ontario, Canada: LGL Ecological Research Associates, Inc., pp. 3-72.

Miller, M.C., R.T. Prentki, and R.J. Barsdate. 1980. Physics of the Ponds. *In*: Limnology of Tundra Ponds, Barrow, Alaska. J.E. Hobbie, (ed.). US/IBP Synthesis Series 13. Stroudsburg, PA: Dowden, Hutchinson, and Ross., pp. pp. 51-75 514 pp.

Miller S.D. and M.A. Chihuly. 1987. Characteristics of Nonsport Brown Bear Deaths in Alaska. *In*: Seventh International Conference on Bear Research and Management-Bears- Their Biology and Management. P. Zager, J. Beecham, G. Matula, and H. Reynolds III, eds. February - March 1986, Williamsburg, Va. 7. Washington, DC: Port City Press, Inc. pp. 51-58.

Milner, A.M. 1991. Timber Harvest and Water Quality in Alaska. Anchorage, AK: USEPA.

Milner, A.M., J.G. Irons, III, and M.W. Oswood. 1995. The Alaskan Landscape: An Introduction for Limnologists. Freshwaters of Alaska Ecological Synthesis. A.M. Milner and M.W. Oswood, eds. New York, NY: Springer-Verlag., pp. pp. 1-44.

Molenaar, C.M. 1988. Depositional History and Seismic Stratigraphy of Lower Cretaceous Rocks in the National Petroleum Reserve in Alaska and Adjacent Areas. *In*: *Geology and Exploration of the National Petroleum Reserve in Alaska, 1974-1982*. G. Gryc, ed. USGS Professional Paper 1399. U.S. Geological Survey, pp. 593-621.

Molenaar, C.M., K.J. Bird, and T.S. Collett. 1986. Regional Correlation Sections Across the North Slope Of Alaska. USGS Miscellaneous Field Studies Map MF1907. U.S. Geological Survey.

Moore, T.E., W.K. Wallace, K.J. Bird, S.M. Karl, C.G. Mull, and J.T. Dillon. 1994. The Geology of Northern Alaska. *In*: *The Geology of Alaska*. G. Plafker and H.C. Berg, eds. The Geology of North America G-1. The Geological Society of America, pp. 49-140.

Morrison, W. 1997. Telephone Conversation Dated May 2, 1977, Between Wayne Morrison, Chief, Kuparuk Camp Services, ARCO Alaska, and John Tremont, Geographer, USDOI, MMS, Alaska OCS Region. Subject: Airports at Prudhoe Bay.

Morrissey, L.A. and R.A. Ennis. 1981. Vegetation Mapping of the National Petroleum Reserve in Alaska Using Landsat Digital Data. Open-File Report 81-315. Reston, VA: U.S. Geological Survey.

Mould, E. 1979. Seasonal Movement Related to Habitat of Moose Along the Colville River, Alaska. *The Murrelet* 60: 6-11.

Moulton, L.L., L.J. Field, and S. Brotherton. 1986. Assessment of the Colville River Fishery in 1985, Chapter 3. *In*: Colville River Fish Study Annual Report, 1985, J.M. Colonell and L.L. Moulton, eds. Anchorage and Barrow, AK: ARCO Alaska, Inc., North Slope Borough, and City of Nuiqsut.

Moulton, L.L. 1994. Colville Delta Winter Fish Habitat Study 1991- 1993. Final Report. Anchorage, Alaska: ARCO Alaska Inc., 40 pp.

Moulton, L.L. 1997. The 1996 Colville River Fishery. The 1997 Endicott Development Fish Monitoring Program. Volume II. Compiled by LGL, Alaska Research Associates for BP Exploration (Alaska) Inc., Anchorage and North Slope Borough, Barrow, Alaska.

Moulton, L.L., M.H. Fawcett, and T.A. Carpenter. 1985. Lisburne Development Environmental Studies: 1984. Final Report Vol. 4. Anchorage, AK: ARCO Alaska, Inc., Various paging.

Moulton, L.L. and L.J. Field. 1988. Assessment of the Colville River Fall Fishery, 1985-1987. Anchorage, AK: ARCO Alaska, Inc., 41 pp.

Moulton, L.L., L.J. Field, and S. Brotherton. 1986. Assessment of the Colville River Fishery in 1985, Chapter 3. *In*: Colville River Fish Study Annual Report, 1985, J.M. Colonell and L.L. Moulton, eds. Anchorage and Barrow, AK: ARCO Alaska, Inc., North Slope Borough, and City of Nuiqsut.

Mueller, K. 1997. Telephone Conversation in September, 1997 From Caryn Smith, USDOI, MMS Alaska OCS Region, to Keith Mueller, U.S. Fish and Wildlife Service, Fairbanks Office. Subject: Area of Oil Misted Tundra From Spill DS 5-23.

Muller, S.W. 1945. Permafrost or Permanently Frozen Ground and Related Engineering Problems. Special Report. Strategic Engineering Study 62. US Army, Office Chief of Engineers, Military Intelligence Div., 231 pp. Reprinted in 1947 by J.W. Edwards, Inc., Ann Arbor, Mich.

Murphy, J.M. 1965. Social Science Concepts and Cross-Cultural Methods for Psychiatric Research. *In*: Approaches to Cross-Cultural Psychiatry, J.M. Murphy and A.H. Leighton, eds. Ithaca, NY: Cornell University Press, pp. 251-84.

Murphy, G.M. and J.A. Curatolo. 1984. Responses of Caribou to Ramps and Pipelines in the West End of the Kuparuk Oilfield, Alaska, 1983. Final Report. Anchorage, AK: ARCO Alaska, Inc.

Murphy, L.S. and R.A. Belastock. 1980. The Effect of Environmental Origin on the Response of Marine Diatoms to Chemical Stress. *Limnology and Oceanography* 25: 160-165.

Murphy, S.M., and Anderson, B.A. (Alaska Biological Research Inc.). Lisburne Terrestrial Monitoring Program: The Effects of the Lisburne Development Project on Geese and Swans, 1985-1989. Fairbanks, AK: ARCO Alaska, Inc., 1993. Final Synthesis Report Prepared for ARCO Alaska, Inc., 255 pp.

Napageak, T. 1995. Testimony at the Public Hearing on the Beaufort Sea Sale 144 DEIS, Nov. 6, 1995, Nuiqsut Ak. Anchorage Ak: USDOI, Minerals Management Service, 36 pp.

Napageak, T. 1997 (Testimony). Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Nuiqsut, Alaska, Thursday, April 10, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM, 28 pp.

Nelson, G.L. and J.A. Munter. 1990. Ground Water. *In*: Cold Regions Hydrology and Hydraulics. W.L. Ryan and R.D.E. Crissman, eds. TECHNICAL Council on Cold Regions Engineering Monograph. American Society of Civil Engineers, pp. 317-348.

Nelson, R.K. 1969. *Hunters of the Northern Ice*. Chicago and London: University of Chicago Press.

Netsch, F.N., E. Crateau, G. Love, and N. Swanton. 1977. Preliminary Report - Freshwater Fisheries Reconnaissance of the Coastal Plain of National Petroleum Reserve - Alaska Vol. 1. Anchorage, AK: USDOI, FWS. Various paging.

Niebauer, H.J., V. Alexander, and R.T. Cooney. 1981. Primary Production at the Eastern Bering Sea Ice Edge: The Physical and Biological Regimes. *In*: The Eastern Bering Sea Shelf: Oceanography and Resources, D.W. Hood and J.A. Calder, eds. Vol. 2. Boulder, CO: USDOC, NOAA, OMPA, and USDOI, BLM, pp. 736-772. Distributed by the University of Washington Press, Seattle, Wash.

North, M.R., Poole, A. and Gill, F., Editors. Yellow-Billed Loon. Philadelphia, PA: American Ornithologists' Union and Academy of Natural Sciences, 1994. The Birds of North America No. 121.

North Slope Borough Contract Staff. 1979. Native Livelihood and Dependence: A Study of Land Values Through Time. Field Study (National Petroleum Reserve in Alaska 105(c) Land Use Study (US) 1. Anchorage, AK: USDOI, BLM, NPR-A Work Group 1, 166 pp.

North Slope Borough. 1993. North Slope Borough 1992 Economic Profile, Volume VI.

North Slope Borough. 1995. North Slope Borough 1993/94 Economic Profile and Census Report, Volume VII. NSB, Dept. of Planning and Community Services.

North Slope Borough. 1983. Title 19, Land Use Regulations, Effective January 1, 1983. Barrow, AK: NSB.

North Slope Borough. No date. Traditional Land Use Inventory. Barrow, AK: NSB Commission on Inupiat History, Language, and Culture.

North Slope Borough Contract Staff. 1979. Native Livelihood and Dependence: A Study of Land Values Through Time. Field Study 1 (National Petroleum Reserve in Alaska 105(c) Land Use Study (FS-1)). Anchorage, AK: USDOI, BLM, NPR-A Work Group 1. 166 pp.

North Slope Borough, Dept. of Planning and Community Services. 1989. North Slope Borough Census: Preliminary Report on Population and Economy. Draft Report. Barrow, AK: NSB Dept. of Planning and Community Services, Warren Matumeak, Director. Prepared by William E. Nebesky.

Northstar Project Community Meeting, Nuiqsut, Alaska, March 27, 1996. Anchorage, AK: Dames & Moore. 10 pp.

Northstar Project Whalers' Meeting, Nuiqsut, Alaska, August 1-2, 1996. Whaling Captains' Meeting. Anchorage, AK: Dames & Moore. 10 pp.

Northstar Project Community Meeting, Nuiqsut, Alaska, August 13-15, 1996. Anchorage, AK: Dames & Moore. 10 pp.

Northcott, P.L. 1984. Impact of the Upper Salmon Hydroelectric Development on the Grey River Herd. In: Abstracts, 2nd North American Caribou Workshop, Meredith E., Chairman, October 17-20, 1984, Montreal, Quebec, Canada. Montreal: McGill University. p6. NPR-A compiler. 1996. NPR-A: A Briefing Book. Anchorage, AK: USDOI, BLM. 6 pp.

Nukapigak, E. 1997. (Testimony). Public Scoping for the NPR-A Integrated Activity Plan Environmental Impact Statement, Nuiqsut, Alaska, Thursday, April 10, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM. 28 pp.

O'Brien, W.J., M. Bahr, A.E. Hershey, J.E. Hobbie, G.W. Kipphut, G.W. Kling, H. Kling, M. McDonald, M.C. Miller, P. Rublee, and J.R. Vestal. 1997. The Limnology of Toolik Lake. Freshwaters of Alaska: Ecological Syntheses. A.M. Milner and M.W. Oswood, eds. New York, NY: Springer-Verlag. pp. 61-106.

Okakok, L. 1995. Testimony at the Public Hearing on the Beaufort Sea Sale 144 DEIS, Nov. 8, 1995, Barrow, AK. Anchorage, AK: USDOI, MMS, Alaska OCS Region. 101 pp.

Okakok, R. 1987. Testimony at the Public Hearing on Oil and Gas Lease Sale 109 DEIS, Apr. 10, 1987, Barrow, AK. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Olson, T.L., B.K. Gilbert, Author. 1994. Variable Impacts of People on Brown Bear Use of an Alaskan River. *In*: Ninth International Conference on Bear Research and Management. J.J. Claar and P. Schullery, Editors. February 1992, Missoula, Montana. 9(1). International Association for Bear Research and Management. 97-106. 500 pp.

Opie, R.T., H. Brower, Jr., and D. Bates. In prep. North Slope Borough Subsistence Harvest Documentation Project: Data for Atqasuk, Alaska for the Period July 1, 1994 to June 30, 1995. Barrow, AK: North Slope Borough, Department of Wildlife Management.

Orbach, M. and B. Holmes. 1984. Sociocultural and Socioeconomic Description of St. George and St. Paul Islands. Dept. of Commerce Environmental Impact Statement on Renegotiation of the North Pacific Fur Seal Convention. Washington, DC: USDOC.

Oritsland, N.A., F.F.A., F.R. Engelhardt, R.J. Hurst, and Watts, P.D. 1981. Effects of Crude Oil on Polar Bears. Environmental Study 24. Canada: Canadian Dept. of Northern Affairs. 268pp.

Ott, A.G. 29 August 1997. Letter to Johanna Munson, State NPR-A Representative. Subject: NPR-A Review.

Pacific Meridian Resources. 1996. National Petroleum Reserve-Alaska Landcover Inventory: Phase 2, Eastern NPR-A. Sacramento, CA: Pacific Meridian Resources. 1996. Unpublished Report.

Pacific Meridian Resources. 1996. National Petroleum Reserve-Alaska Landcover Inventory: Phase 2, Eastern NPR-A. Interim Report PMR Job No. 401. Sacramento, CA: Pacific Meridian. 1996. 29 pp.

Paul, G.S. 1988. Physiological, Migrational, Climatological, Geophysical, Survival, and Evolutionary Implications of Cretaceous Polar Dinosaurs. Journal of Paleontology 62(4): 640-652.

Peakall, D.B., D. Hallett, D.S. Miller, R.G. Butler, and W.B. Kinter. 1980. Effects of Ingested Crude Oil on Black Guillemots: a Combined Field and Laboratory Study. *Ambio* 9: 28-30.

Pearce, J.B. 1992. Marine Vessel Debris: A North American Perspective. *Marine Pollution Bulletin* 24(12): 586-592.

Pedersen, S. In prep. Nuiqsut: Wild resource Harvest and Uses in 1993. Fairbanks, AK: Alaska Department of Fish and Game, Division of Subsistence.

Pedersen, S. 1995a. Kaktovik. Chapter XXI. *In*: An Investigation of the Sociocultural Consequences of Outer Continental Shelf Development in Alaska. J.A. Fall and C.J. Utermohle, eds. Vol. V. Anchorage, AK: State of Alaska, Dept. of Fish and Game, Div. of Subsistence.

Pedersen, S. 1995b. Nuiqs[illegible]ter XXII. *In*: An Investigation of the Sociocultural Consequences of Outer Continental Shelf Development in Alaska. Anch[illegible]: State of Alaska, Dept. of Fish and Game, Div. of Subsistence.

Pedersen, S. 1995b. Nuiqsut. Chapter XXII. *In*: An Investigation of the Sociocultural Consequences of Outer Continental Shelf Development in Alaska. Anchorage, AK: State of Alaska, Dept. of Fish and Game, Div. of Subsistence.

Pedersen, S. 1996. Nuiqsut: Wild Resource Harvests and Uses in 1993. ADF&G Summary Paper. Fairbanks, AK: ADF&G, Division of Subsistence.

Pedersen, S. 1997. Presentation at the NPR-A Symposium Proceedings, Anchorage, Alaska, April 17, 1997. Michael Burwell's Notes. 14 pp.

Philo, L.M., G.M. Carroll, and D.A. Yokel. 1993. Movements of Caribou in the Teshekpuk Lake Herd As Determined by Satellite Tracking. Barrow, AK: North Slope Borough. 60 pp.

Philo, L.M., J.C. George, and L.L. Moulton. 1993. The Occurrence and Description of Anadromous and Freshwater Fish in Teshekpuk Lake, Alaska 1990-1992. Barrow, Alaska: North Slope Borough. 96 pp.

Piatt, J.F., C.J. Lensink, W. Butler, M. Kendziorek, and D.R. Nysewander. 1990. Immediate Impact of the Exxon Valdez Oil Spill on Marine Birds. *The Auk* 107: 387-397.

Picou, J.S., D.A. Gill, C.L. Dyer, and E.W. Curry. 1992. Disruption and Stress in an Alaskan Fishing Community: Initial and Continuing Impacts of the *Exxon Valdez* Oil Spill. *Industrial Crisis Quarterly* 6(3):235-257.

Picou, J.S. and D.A. Gill. 1993. Long-Term Social Psychological Impacts of the *Exxon Valdez* Oil Spill. *In*: *Exxon Valdez* Oil Spill Symposium Abstract Book. B. Spies, L.J. Evans, B. Wright, M. Leonard, and C. Holba, eds. and comps., Feb. 2-5, 1993, Anchorage, Ak. Anchorage, AK: *Exxon Valdez* Oil Spill Trustee Council, University of Alaska Sea Grant College Program, and American Fisheries Society, Alaska Chapter, pp. 223-26.

Pollard, R.H. and W.B. Ballard. 1993. Caribou Distribution in the Prudhoe Bay Oil Field, Summer 1992. Northern Alaska Research Studies. Anchorage AK: LGL Alaska Research Associates, Inc. for Bp Exploration (Alaska) Inc.

Prentki, R.T. and C.M. Anderson. 1996. Trends in Occurrence Rates for Offshore Oil Spills and the Beaufort Sea. In: Alaska OCS Region Proceedings of the 1995 Arctic Synthesis Meeting. MBC Applied Environmental Sciences, Report Preparation. October 23-25, 1995, Anchorage, AK. OCS Study MMS 95-0065. Anchorage, AK: United States, DOI, MMS, Alaska OCS Region, pp. 187-94.

Prentki, R.T., M.C. Miller, R.J. Barsdate, V. Alexander, J. Kelly, and P. Coyne. 1980. Chemistry of the Ponds. *In*: Limnology of Tundra Ponds, Barrow, Alaska. J.E. Hobbie (ed.). US/IBP Synthesis Series 13. Stroudsburg, PA: Dowden, Hutchinson, and Ross, pp. pp. 76-178 514 pp.

Quakenbush, L. 1996. Overview of Species That May Be Affected by Development Within the Arctic Alaska OCS Region. *In*: Proceedings of the 1995 Arctic Synthesis Meeting. T. Newbury, ed. Oct. 23-25, 1995, Anchorage, AK. OCS Study, MMS 95-0065. Anchorage, AK: USDOI, MMS, Alaska OCS Region, pp. 131-137.

Quakenbush, L. and J.T. Cochrane. 1993. Report on the Conservation Status of the Steller's Eider (*Polysticta Stelleri*), a Candidate Threatened and Endangered Species. Unpublished report. Anchorage, Alaska: USDOI, FWS. 26 pp.

Quakenbush, L., R.S. Suydam, K.M. Fluetsch, and C.L. Donaldson. 1995. Breeding Biology of Steller's Eiders Nesting Near Barrow, Alaska 1991-1994. Technical Report NAES-TR-95-03. Fairbanks, Ak: USDOI, FWS. 53 pp.

Quinlan, S.E. and W.A. Lehnhausen. 1982. Arctic Fox, Alopex Lagopus, Predation on Nesting Common Eiders, Somateria Mollissima at Icy Cape, Alaska. *Canadian Field Naturalist* 96(4): 462-466.

Rahn, K.A. 1982. On the Causes, Characteristics and Potential Environmental Effects of Aerosol in the Arctic Atmosphere. *In*: The Arctic Ocean: The Hydrographic Environment and the Fate of Pollutants. L. Rey, ed. New York: John Wiley and Sons, pp. 163-195.

Ramsay, M.A. and I. Stirling. 1990. Fidelity of Female Polar Bears to Winter-Den Sites. *Journal of Mammalogy* 71(2): 233-236.

Rankin, G. 1979. Testimony at the Public Hearing on the BF Oil and Gas Lease Sale, May 15, 1979, Kaktovik, Ak. Anchorage, AK: USDOI, MMS, Alaska OCS Region. 92 pp. plus attachments.

Raveling, D.G. 1989. Nesting-Predation Rates in Relation to Colony Size of Black Brant. *Journal Wildlife Management* 53(1): 87-90.

Reynolds, M.K. and N.A. Felix. 1989. Airphoto Analysis of Winter Seismic Disturbance in Northeastern Alaska. *Arctic* 42(4): 362-367.

Reanier, R.E. 1977. Regional Cultural History and Prehistoric Sites (10,000 B.C. to 1,500 A.D.). A paper presented at the NPR-A Symposium: Science, Traditional Knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve in Alaska, Apr. 16-18, 1997, Anchorage, Ak. Anchorage, AK: USDOI, BLM and MMS, Alaska OCS Region.

Reardon, J. 1981. Alaska Mammals. Vol. Vol 8 No 2. Anchorage AK: Alaska Geographic Society. 184 pp.

Reimers, E. 1980. The Major Determinant for Growth and Fattening in *Rangifer*. *In*: Proceedings of the Second International Reindeer/Caribou Symposium. E. Reimers, E. Gaare, and S. Skjenneberg, eds. 1980. Roros, Norway 466-74.

Reimnitz, E., P.W. Barnes, and R.L. Phillips. 1982. Sixty-Meter-Deep Pressure-Ridge Keels in the Arctic Ocean Suggested From Geological Evidence. *In*: Geologic Processes and Hazards of the Beaufort and Chukchi Sea Shelf and Coastal Regions. OCSEAP Final Reports of Principal Investigators, Vol. 34(Aug. 1985). Boulder, CO: USDOC, NOAA, and USDOI, MMS. pp. 295-312.

Reynolds P.E., author. 1986. Responses of Muskox Groups to Aircraft Overflights in the Arctic National Wildlife Refuge, 1982-1985. in: Arctic National Wildlife Refuge Coastal Plain Resource Assessment. a P.E.R. G.W. Garner, editors. 1985 Update Report. Baseline Study of the Fish, Wildlife, and Their Habitats Vol 3Appendix V., Impacts. ANWR Progress Report No. FY86-5-Impacts. Anchorage AK: USDOI USF&W, 1281pp.

Reynolds P.E. D.J. LaPlant, authors. 1985. Effects of Winter Seismic Exploration Activities on Muskoxen in the Arctic National Wildlife Refuge, January-May 1984. in: Arctic Natioanal Wildlife Refuge Coastal Palin Resource Assessment, G.W. Garner and P.E. Reynolds, editors. 1984 Update Report. Baseline Study of the Fish, Wildlife, and Their Habitats Vol I. ANWR Progress ReportNO FY85-2. Anchroage Ak: USDOI USF&W, 777 PP.

Reynolds P.E. D.J. LaPlant, authors. 1986. Effects of Winter Seismic Exploration Activities on Muskoxen in the Arctic National Wildlife Refuge, January-May, 1984-1985. in: Arctic National Wildlife Refuge Coastal Plain Resource Assessment, G.W. Garner and P.E. Reynolds, editors. 1985 Update Report Baseline Study of the Fish, Wildlife, and Their Habitats. Impacts. ANWR Progress Report No. FY86-4 Vol 3Appendix V. Anchorage AK: USDOI, USF&W, 1281 pp.

Reynolds, P.E., J. Reynolds H.V. and F.H. Follmann. 1986. Responses of Grizzly Bears to Seismic Surveys in Northern Alaska. International Conference Bear Research and Management. 6:169-75.

Rice, S. 1997. On-Shore Geophysical (Seismic) Exploration. In: NPR-A Symposium Draft Proceedings. T. Newbury and K.L. Mitchell, Coordinators. April 16-18, 1997, Anchorage, AK. OCS Study MMS 97-0013. Anchorage, AK: United States DOI, MMS, Alaska OCS Region and BLM. pp. 1-1 -1-6.

Richardson, W.J. and C.I. Malme. 1993. Man-Made Noise and Behavioral Responses. *In*: The Bowhead Whale Book. J.J. Burns, J.J. Montague, and C.J. Cowles, eds. Special Publication of The Society for Marine Mammalogy 2. D. Wartzok, ed. Lawrence, KS: The Society for Marine Mammalogy., pp. 631-700.

Rieger, S., D.B. Schoephorster, and C.E. Furbush. 1979. Exploratory Soil Survey of Alaska. GPO 1979-247-478/68. Anchorage, AK: U.S. Dept. of Agriculture, Soil Conservation Service. 213 pp plus 30 maps.

Ritchie, R.J. 1979. A Survey of Cliff-Nesting Raptors and Their Habitats. Final Repost. Final Report. Fairbanks AK: ARCO Alaska, Inc. and the Kuparuk River Unit Owners.

Ritchie, R.J. and Rose, J.R. (Alaska Biological Research, Inc., Fairbanks, AK). Aerial Surveys for Nesting and Brood-Rearing Brant, Barrow to Fish Creek, Alaska, 1996. Fairbanks, AK: ABR, Inc., 1996. 19 pp (Final Report).

Robertson, S.B. 1989. Impacts of Petroleum Development in the Arctic. Science 245: 18 August 1989. 245-246.

Robertson, S.B. 1989. Impacts of Petroleum Development in the Arctic [Technical Comment]. *Science* 245: 764-765. Walker et al. 1987, 1989.

Roby D. 1978. University of Alaska, Fairbanks 500pp. Master Thesis UAF.

Roby, D.D. 1980. Winter Activity of Caribou on Two Arctic Ranges. *In*: Proceedings of the Second Internationa Reindeer/Caribou Symposium. E. Reimers, E. Gaare, and S. Skjenneberg, eds. 1980. Roros, Norway.pp. 537-43.

Rovkas, A.J. 1997. Telephone Conversation Dated May 19, 1997 Between A.J. Rovkas, Project Manager, Lounsbury & Assocs., Inc., and John Tremont, Geographer, USDOI, MMS, Alaska OCS Region. Subject: Oliktok Dock.

Rowe, L., J. Dollahite, and B. Camp. 1973. Toxicity of Two Crude Oils and of Kerosene to Cattle. *Journal of American Veterinary Medicine Association* 16: 60-66.

Sakeagak, E. 1987. In: Arundale, W.H. and W.S. Schneider. Quliaqtuat Inupiat Nunaninnin: The Report of the Chipp-Ikpikpuk River and Upper Mead River Oral History Project. A Report for the North Slope Borough Commission on History, Language, and Culture.

Sackinger, W.M., G. Weller and S.T. Zimmerman. 1983. Outer Continental Shelf Environmental Assessment Program: Beaufort Sea (Sale 87) Synthesis Report. AlnA. Proceedings of a Synthesis Meeting. Jan 25-28, 1983, Chena Hot Springs, Alaska. Juneau AK: USDOC, NOAA and USDOI, MMS.

Schallenberger A. 1980. Review of Oil and Gas Exploitation Impacts on Grizzly Bears. *In*: Bears-Their Biology and Management. Fourth International Conference on Bear Research and Management. C.J. Martinka and K.L. McArthur, eds. February 1977, Kalispell, Mont. 4. Tonto Basin, AZ: Bear Biology Association. pp. 271-77.

Schamel, D., ed. 1978. Birds. *In*: Environmental Assessment of the Alaska Continental Shelf Interim Synthesis: Beaufort/Chukchi. Boulder CO: USDOC, NOAA, OCSEAP and USDOI, BLM. pp. 152-173.

Schell, D.M. and R.A. Horner. 1981. Primary Production, Zooplankton, and Trophic Dynamics. Chapter 1. *In*: Proceedings of a Synthesis Meeting: Beaufort Sea Sale 71 Synthesis. D.W. Norton and W.M. Sackinger, eds. Apr. 21-23, 1981, Chena Hot Springs, Ak. Juneau, AK: USDOC, NOAA, OCSEAP, and USFWS, BLM. pp. 3-11.

Schell, D.M., P.J. Ziemann, D.M. Parrish, K.H. Dunton, and E.J. Brown. 1982. Foodweb and Nutrient Dynamics in Nearshore Alaska Beaufort Sea Waters. RU 537. OCSEAP Final Reports of Principal Investigators, Volume 25 (October 1984). Anchorage, AK: USDOC, NOAA, and USDOI, MMS, pp. 21-104 and 327-499.

Schliebe, S.L. 1983. Alaska Polar Bear Harvest Characteristics 1980-1982 Status Report. Anchorage, AK: USDOI, FWS Region 7.

Schmidt, D.R., R.O. McMillan, and B.J. Gallaway. 1989. Nearshore Fish Survey in the Western Beaufort Sea Harrison Bay to Elson Lagoon. *In*: Outer Continental Shelf Environmental Assessment Program - Final Reports of Principal Investigators. OCS Study, MMS 89-0071. Vol. 63. Anchorage, AK: USDOC, NOAA, and USDOI, MMS, Alaska OCS Region, pp. 491-552.

Schneider, W., S. Pedersen, and D. Libbey. 1980. The Barrow-Atqasuk Report: A Study of Land Use Through Time. Occasional Paper No. 24. Fairbanks, AK: University of Alaska, Fairbanks, Anthropology and Historic Preservation Cooperative Park Studies Unit; and the North Slope Borough.

Schneider, W., S. Pedersen, and D. Libbey. 1980. Barrow-Atqasuk: Land Use Values Through Time in the Barrow-Atqasuk Area. Occasional Paper 24. Fairbanks, AK: University of Alaska, Anthropology & Historic Preservation Cooperative Park Studies Unit and North Slope Borough.

Sellman, P.V., J. Brown, R.I. Lewellen, H. McKim, and C. Merry. 1975. The Classification and Geomorphic Implications of Thaw Lakes on the Arctic Coastal Plain, Alaska. CRREL Research Report 344. USDOD, US Army COE, CRREL, 21 pp.

Shannon and Wilson Consultants. 1996. Flood-Frequency Analysis for the Colville River, North Slope, Alaska. Anchorage, AK: Michael Baker, Jr., Inc.

Shapiro, L.H., R.C. Metzner, and K. Toovak. 1979. Historical References to Ice Conditions Along the Beaufort Sea Coast of Alaska. UAG-R-268. Fairbanks, AK: University of Alaska, Geophysical Institute, 65 pp.

Shatick, D. 1997. Telephone Conversation in April, 1997 from Caryn Smith, USDOI, MMS Alaska OCS Region, to Doug Shatick, Alyeska Pipeline Service Company; Subject: TAPS Throughput for 1996.

Sheehan, G.W. 1997. Overview of Late Prehistoric Sites and Culture. A paper presented at: The NPR-A Symposium: Science, Traditional Knowledge, and the Resources of the National Petroleum Reserve in Alaska, Apr. 16-18, 1997, Anchorage, AK. Anchorage, AK: USDOI, BLM, and MMS, Alaska OCS Region.

Shepard S., K. Bennett, J.K. Gilliam, authors. 1980. National Petroleum Reserve in Alaska (NPR-A) Technical Examinations, TE-1: An Analysis of the Type and Likely Level of NPR-A Oil Development(s). Fairbanks AK: USDOI BLM.

Sherwood, K.W., ed. 1996. Assessment Data for Oil and Gas Potential of Alaska Federal Offshore. Anchorage, AK: USDOI, MMS, Alaska OCS Region. Internet address: http://www.mms.gov/omm/alaska/re/asmtdata.html.

Sherwood, K.W., J.D. Craig, and L.W. Cooke. 1996. Endowments of Undiscovered Conventionally Recoverable Oil and Gas in the Alaska Federal Offshore (As of January 1995). OCS Report, MMS 96-0033. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 17 pp.

Shideler, R. and J. Hechtel. 1995. Grizzly Bear Use of Oil Fields Around Prudhoe Bay, Alaska. *In*: Tenth International Conference on Bears Resources and Management, July 16-20, 1995, Fairbanks, Ak. Fairbanks, Ak.

Shindler, J.F. 1988. History of Exploration in the National Petroleum Reserve in Alaska, With Emphasis on the Period From 1975 to 1982. *In*: *Geology and Exploration of the National Petroleum Reserve in Alaska, 1974-1982*, G. Gryc, ed. USGS Professional Paper 1399. U.S. Geological Survey, pp. 13-72.

Skoog, R.O. 1968. Ecology of the Caribou (Rangifer Tarandus Granti) in Alaska. Dissertation. Berkeley, CA: University of California.

Sloan, C.E. 1987. Water Resources of the North Slope, Alaska. *In*: Alaska North Slope Geology. I. Tailleur and P. Weimer, eds. The Pacific Section, Society of Economic Paleontologists and Mineralogists, and The Alaska Geological Society.

Smith, T.E. 1989. The Status of Muskoxen in Alaska. *In*: Proceedings of the Second International Muskoxen Symposium, P.I. Flood, ed., Oct. 1-4, 1987, Saskatoon, Saskatchewan, Canada. Ottawa, Canada: National Research Council of Canada, 350 pp.

Smith W.T., R.D. Cameron, author. 1986. Distribution and Movements of Caribou in Relation to the Kuparuk Development Area. ADF&G Final Report. W21-2, W22-1, W22-2, W22-3, W22-4, W22-5, Job 3.3. Federal Aid in Wildlife Restoration Project. Juneau Ak: ADF&G, 30 pp.

Smith W.T., R.D. Cameron, D.J. Reed, authors. 1994. Distribution and Movements of Caribou in Relation to Roads and Pipelines, Kuparuk Development Area. ADF&G Wildlife Technical Bulletin No. 12. Juneau Ak: ADF&G, 54 pp.

Smythe, C.W. and R. Worl. 1985. Monitoring Methodology and Analysis of North Slope Institutional Response and Change, 1979-1983. OCS Study, MMS 85-0072. Technical Report No. 117. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program.

Sohio Alaska Petroleum Company. 1984. Caribou White Paper: An Evaluation of the Proposed Endicott Development Project Regarding Potential Impacts to Caribou. Anchorage, AK: Sohio Alaska Petroleum Co., Environmental Affairs Dept.

Sopuck, L.G., D.J. Vernam. 1986. Distribution and Movements of Moose (Alces Alces) in Relation to the Trans-Alaska Pipeline. *Arctic* 39(2): 138-144.

Sopuck, L.G., D.J. Vernam, authors. 1984. Late Winter Distribution and Movements of Moose in Relation to the Trans-Alaska Pipeline in Interior Alaska. Anchorage, AK: Alyeska Pipeline Service Company. 92pp.

Speich, S.M. 1989. Catalog of Washington Seabird Colonies. OCS Study, MMS 89-0054. FWS Biological Report 88(6). Washington, DC and Camarillo, CA: USDOI, FWS, and USDOI, MMS, Pacific OCS Region.

Spetzman, L.A. 1959. Vegetation of the Arctic Slope of Alaska. Exploration of Naval Petroleum Reserve No. 4 and Adjacent Areas, Northern Alaska, 1944-1953, Part 2, Regional Studies. USGS Professional Paper 302-B. U.S. Geological Survey, pp. 34.

Stanford, D.J. 1976. The Walakpa Site, Alaska. *Smithsonian Contributions to Anthropology* 20.

Starr, S.J., M.N. Kuwada, and L.L. Trasky. 1981. Recommendations for Minimizing the Impacts of Hydrocarbon Development on the Fish, Wildlife, and Aquatic Plant Resources of the Northern Bering Sea and Norton Sound. Anchorage, AK: State of Alaska, Dept. of Fish and Game, Habitat Div. 525 pp. In Sale 100, biblio. page 49.

State of Alaska, DEC. 1997. 18 AAC 70 Water Quality Standards As Amended Through March 28, 1997. Juneau, AK: State of Alaska, DEC. 44 pp.

State of Alaska, Dept. of Community and Regional Affairs. 1997. Community Profiles.

State of Alaska, Dept. of Fish and Game. 1995d. Community Profile Database. Vol. 5, Arctic Region. Juneau, AK: State of Alaska, Dept. of Fish and Game, Div. of Subsistence.

State of Alaska, Department of Natural Resources. 1995. Five-Year Oil and Gas Leasing Program. Anchorage, AK: State of Alaska, DNR. 86 pp.

State of Alaska, Department of Natural Resources. 1997. Historical and Projected Oil and Gas Consumption. Anchorage, AK: State of Alaska, DNR. 67 pp.

State of Alaska, Dept. of Environmental Conservation. 1982. Air Quality Control Regulations 18AAC 50. Juneau, AK: State of Alaska, Dept. of Environmental Conservation. 31 pp.

State of Alaska, D.o.F.a.G. In prep. Annual Management Report, Yukon Area, 1995. S.K.C.B.B.M.S.G.J.B.L.H.S.D.J.H.T.S. Bergstrom D.J. eds. Regional Information Report 3A97-14. Anchorage, AK: State of Alaska, Dept. of Fish and Game, CFMD. 266 pp.

State of Alaska, D.o.F.a.G. 1995b. Community Profile Database. Vol. 5, Arctic Region. Juneau, AK: State of Alaska, Dept. of Fish and Game, Div. of Subsistence.

State of Alaska, D.o.L. 1995. Employment and Earnings Summary Report. Annual Reports 1991-1994. Anchorage, AK: State of Alaska, Dept. of Labor.

State of Alaska, D.o.T.a.P.F. 1996. Northern Regions Traffic Volume Reports for 1995. Fairbanks, AK: State of Alaska, DOT/PF.

State of California, Dept. of Fish and Game. 1988. Review of Some California Fisheries for 1987. CalCOFI Report XXIX:11-20. Sacramento, CA: State of California, Dept. of Fish and Game.

Steinhauer, M.S. and P.D. Boehm. 1992. The Composition and Distribution of Saturated and Aromatic Hydrocarbons in Nearshore Sediments, River Sediments, and Coastal Peat of the Alaskan Beaufort Sea: Implications for Detecting Anthropogenic Hydrocarbon Inputs. Marine Environmental Research 33: 223-253.

Steinhauer, M.S. and P.D. Boehm. 1992. The Composition and Distribution of Saturated and Aromatic Hydrocarbons in Nearshore Sediments, River Sediments, and Coastal Peat of the Alaskan Beaufort Sea: Implications for Marine Monitoring Studies. Marine Environmental Research 33: 223-253. MMS Contract 30163.

Stenhouse, G.B., L.J. Lee, and K.G. Poole. 1988. Some Characteristics of Polar Bears Killed During Conflicts With Humans in the Northwest Territories, 1976-86. Arctic 41(4): 275-278.

Stephen R. Braund and Associates. 1989b. North Slope Subsistence Study: Barrow, 1988. OCS Study, MMS 89-0077. Technical Report No. 135. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program.

Stephen R. Braund & Associates with ISER. 1993b. North Slope Subsistence Study: Barrow, 1987, 1988 and 1989. OCS Study, MMS 91-0086. Final Report. Technical Report No. 149. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program. 466 pp.

Stephen R. Braund and Associates. In prep. Subsistence Overview and Impacts. *In*: Beaufort Sea Oil and Gas Development/Northstar Project. Anchorage, AK: USDOD, U.S. Army COE.

Stephen R. Braund & Associates and I.o.S.a.E.R. University of Alaska. 1993. North Slope Subsistence Study - Barrow, 1987, 1988 and 1989. OCS Study, MMS 91-0086. Final Report. Technical Report No. 149. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program. 466 pp.

Stephenson, W.M., D.W. Cramer, and D.M. Burn. 1994. Review of the Marine Mammal Marking, Tagging, and Reporting Program 1988-1992. FWS Technical Report MMM 94-1. Anchorage, AK: USDOI, FWS, Region 7.

Stephenson, W.M., D.W. Cramer, and D.M. Burn. 1994. Review of the Marine Mammal Marking, Tagging, and Reporting Program 1988-1992. USFWS Technical Report MMM 94-1. Anchorage, AK: USDOI, FWS, Region 7.

Stephenson, R.O. 1993. Game Management Subunits 26B and 26C-Central and Eastern Arctic Slope. *In*: Muskoxen, S.M. Abbott, ed. Project W-23-4 and W-23-5, Study 16.0. ADF&G Federal Aid in Wildlife Restoration Survey-Inventory Management Report. Juneau, AK: State of Alaska, Dept. of Fish and Game.

Stevens, C. 1997. Telephone Conversation in August, 1997 From Carve Smith, USDOI, MMS Alaska OCS Region, to Camille Stevens, State of Alaska, Department of Environmental Conservation, Spill Prevention and Response, Juneau Office.; Subject: ADEC Oil Spill Database - Alaska North Slope Blowouts As a Cause of Oil Spills.

Stickel, L.F. and M.P. Dieter. 1979. Ecological and Physiological/Toxicological Effects of Petroleum in Aquatic Birds: A Summary of Research Activities FY 1976 Through FY 1978. FWS/OBS-79/23. Slidell, LA: USDOI, FWS, Biological Services Program. 14 pp.

Stirling, I. 1988. Attraction of Polar Bear Ursus Maritimus to Offshore Drilling Sites in the Eastern Beaufort Sea. *Polar Record* 24:1-8.

Stuart Smith, J.J. and J.H.N. Wennekers. 1977. Geology and Hydrocarbon Discoveries of Canadian Arctic Islands. *American Association of Petroleum Geologists Bulletin* 61(1): 1-27.

Subba Rao, D.V. and T. Platt. 1984. Primary Production of Arctic Waters. *Polar Biology* 3(4): 191-201.

Suydam, R.S., J.C. George, P.B. Nader, and T.F. Albert. 1994. Subsistence Harvest of Bowhead Whales (Balaena mysticetus) By Alaska Eskimos, 1994. Presented as paper SC/47/AS12 to the Scientific Committee of the International Whaling Commission. Meeting held May 1994 in Puerto Vallarta, Mexico.

Suydam, R. 1997. Unpublished field notes on beluga whales. North Slope Borough Department of Wildlife Management.

Suydam, R.S. 1997. NPR-A Symposium Proceedings-Science, Traditional Knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve-Alaska. April 16-18, 1997. Anchorage, AK. OCS Study, MMS 97-0013. Anchorage, AK: USDOI, MMS, Alaska OCS Region. pp.

Suydam, R., Quakenbush, L., Johnson, M., George, J.C., and Young, J. (North Slope Borough, Department of Wildlife Management and USFWS, Northern Ecological Services). Migration of King and Common Eiders past Point Barrow, Alaska, in Spring 1987, Spring 1994, and Fall 1994. Dickson, D.L., Editor. Occasional Paper Canadian Wildlife Service. 1997. (Number 94): pp21-28.

Swem, T. 1996. 1996 Colville River Raptor Survey. Unpublished Report. Fairbanks, AK: USDOI, FWS.

Swem, T. 1997. NPR-A Symposium Proceedings-Science, Traditional Knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve-Alaska. April 16-18, 1997. Anchorage, AK. OCS Study, MMS 97-0013. Anchorage, AK: USDOI, MMS, Alaska OCS Region. pp.

Taalak, N. 1983 (Testimony). Public Teleconference for the Proposed Arctic Sand and Gravel Lease Sale. Anchorage, Alaska January 4, 1983. Minerals Management Service. Anchorage, AK: USDOI, Minerals Management Service. 22 pp.

Talbot, S.S. 1996. Vegetation Mapping in Arctic Alaska: an Annotated Bibliography. *In*: Circumpolar Arctic Vegetation Mapping Workshop Abstracts and Short Papers, C.J. Markon and D.A. Walker eds. Reston, VA: U.S. Geological Survey.

Tetra Tech. 1982. Petroleum Exploration of the NPR-A 1974-1981. Final report. Tetra Tech Report 8200. Tetra Tech. pp. 1-27.

Thompson, D.C. and K.H. McCourt. 1981. Seasonal Diets of the Porcupine Caribou Herd. *American Midland Naturalist* 105(1): 70-76.

Thorsteinson, L.K., L.E. Jarvela, and D.A. Hale. 1991. Arctic Fish Habitat Use Investigations: Nearshore Studies in the Alaskan Beaufort Sea, Summer 1990. Anchorage, AK: USDOC, NOAA, NOS, ORCA. 166 pp.

Thorsteinson, L.K. and W.J. Wilson. 1996. Anadromous Fish of the Central Alaska Beaufort Sea. *In*: The 1996 Endicott Fish Monitoring Program. Synthesis Supplement Volume II: Published Literature for Synthesis. Final Draft. Anchorage, AK: BP Exploration (Alaska) Inc. and North Slope Borough. pp. 141-143.

Titus, K. and L. Beier. 1993. Population and Habitat Ecology of the Brown Bears on Admiralty and Chichagof Islands. Federal Aid in Wildlife Restoration. Research Progress Report Project W-23-4, Study 4.22. Juneau, AK: State of Alaska, Dept. of Fish and Game. 29 pp.

Travis, R. 1989. Unemployment Isn't Prime Factor in Native Suicide. Anchorage, AK: *Anchorage Daily News*.

Treacy, S.D. 1996. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1995. OCS Study, MMS 96-0006. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Environmental Studies Program. 70 pp.

Tremont, J. 1987. Surface-Transportation Networks of the Alaskan North Slope. OCS Report, MMS 87-0010. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Tremont, J.D. 1987. Surface Transportation Networks of the Alaskan North Slope. OCS Report MMS 87-0010. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Trent, J.N. 1986. Brown/Grizzly Bear Survey-Inventory Progress Report Game Management Unit 26A: Western Arctic Slope. *In*: Brown/Grizzly Bear, B. Townsend, ed. Projects W-22-4 and W-22-5, Job 4.0. ADF&G Division of Game Federal Aid in Wildlife Restoration Annual Report of Survey-Inventory Activities XVII Part V. Juneau, AK: State of Alaska, Dept. of Fish and Game. 70 pp.

Trent, J.N. 1986. Moose Survey-Inventory Progress Report Game Management Unit 26A: Western Arctic Slope. *In*: Annual Report of Survey-Inventory Activities Part VIII Moose, B. Townsend, ed. Project W-22-4, Job 1.0. ADF&G Federal Aid in Wildlife Restoration XVI. Juneau, AK: State of Alaska, Dept. of Fish and Game. 143 pp.

Troy, D.M. (LGL Alaska Research Associates). Bird Use of The Prudhoe Bay Oil Field During the 1986 Nesting Season. Anchorage, AK: Alaska Oil and Gas Association, 1988. Report Prepared for the Alaska Oil and Gas Association. 96 pp.

Troy, D.M. 1988. Bird Use of the Prudhoe Bay Oil Field During the 1986 Nesting Season. Anchorage, AK: Alaska Oil and Gas Association. 96 pp. Prepared for Alaska Oil and Gas Association, 121 W. Fireweed Lane, Suite 207, Anchorage, AK 99503-2035.

Troy, D.M. and Carpenter, T.A. (Troy Ecological Research Associates (TERA)). The Fate of Birds Displaced by the Prudhoe Bay Oilfield: The Distribution of Nesting Birds Before and After P-Pad Construction. Anchorage, AK: BP Exploration, Alaska, Inc., 1990. TERA 90-2. 51 pp. Final Report.

Troy, D.M. 1993. Bird Use of the Prudhoe Bay Oil Field. Anchorage, AK: BP Exploration (Alaska) Inc. 58 pp.

Troy Ecological Research Associates (TERA). 1995. Distribution and Abundance of Spectacled Eiders in the Vicinity of Prudhoe Bay, Alaska: 1991-1993. Northern Alaska Research Studies. Anchorage, AK: BP Exploration (Alaska) Inc.

Troy Ecological Research Associates (TERA). 1993. Distribution and Abundance of Spectacled Eiders in the Vicinity of Prudhoe Bay, Alaska: 1992 Status. Northern Alaska Research Studies. Anchorage, AK: BP Exploration (Alaska) Inc.

Troy Ecological Research Associates (TERA). 1996b. Distribution and Abundance of Spectacled Eiders in the Vicinity of Prudhoe Bay, Alaska: 1995 Status Report. Northern Alaska Research Studies. Anchorage, AK: BP Exploration (Alaska) Inc.

Troy Ecological Research Associates (TERA). 1996a. Distribution and Abundance of Spectacled Eiders in the Vicinity of Prudhoe Bay, Alaska: 1994 Status Report. Northern Alaska Research Studies. Anchorage, AK: BP Exploration (Alaska) Inc.

Tyler, N.J.C. 1991. Short-Term Behavioral Responses of Svalbard Reindeer Rangifer Tarandus Platyrhynchus to Direct Provocation by a Snowmobile. *Biological Conservation* 56: 179-194.

U.S. Department of Labor, B.O.L.S. Annual Reports. Historical Report on Labor Force and Employment. North Slope Borough Labor Force 1975-1995 (Workers residing permanently in the NSB).

U.S. Department of the Interior, M. 1977. Memorandum From USDOI, MMS, Alaska OCS Region to USDOI, BLM, State Director. Subject: Resource Estimates for Western National Petroleum Reserve-Alaska.

USDOI, MMS, Alaska OCS Region. 1996a. Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final Environmental Impact Statement. 2 Vols. OCS EIS/EA MMS 96-0012. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

U.S. Dept. of Agriculture. 1996. Annual Data Summary: Alaska Cooperative Snow Survey, Water Year 1995. USDA, National Resources Conservation Service. 21 pp.

U.S. Environmental Protection Agency. 1978. Alaska Environmental Quality Profile. Seattle, WA: USEPA, Region 10. 29 pp.

U.S. Fish and Wildlife Service, editor. 1995. Stock Assessments Polar Bears (Ursus Maritimus): Alaska Chukchi/Bering Sea Stock, Beaufort Sea Stock. Anchorage, AK: USF&W. 20 pp.

U.S. Geological Survey. 1978. Water Resources Data for Alaska Water Year 1978. Water-Data Report AK-78-1. Reston, VA: U.S. Geological Survey. 425 pp.

U.S. Geological Survey. 1979. Water Resources Data for Alaska Water Year 1979. Water-Data Report AK-79-1. Reston, VA: U.S. Geological Survey. 365 pp.

U.S. Geological Survey. 1980. Water Resources Data for Alaska Water Year 1980. Water-Data Report AK-80-1. Reston, VA: U.S. Geological Survey. 373 pp.

U.S. Geological Survey. 1982. Water Resources Data for Alaska, Water Year 1982. Water-Data Report AK82-1. Reston, VA: U.S. Geological Survey, 363 pp.

U.S. Geological Survey. Water Resources Data for Alaska, Water Year 1986. Water-Data Report AK82-1. U.S. Geological Survey, 278 pp.

U.S. Geological Survey. 1996. Water Resources Data for Alaska, Water Year 1995. Water-Data Report AK95-1. Reston, VA: U.S. Geological Survey, 278 pp.

University of Alaska, Institute for Social and Economic Research. 1986. Economic and Demographic Systems of the North Slope Borough Beaufort Sea Lease Sale 97 and Chukchi Sea Lease Sale 109. OCS Study, MMS 86-0019. Technical Report No. 120. 2 Vols. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Social and Economic Studies Program.

University of Alaska, Institute for Social and Economic Research. 1979. Western Gulf of Alaska - Economic and Demographic Impacts. Technical Report No. 38. Anchorage, AK: USDOI, BLM, Alaska OCS Office, Socioeconomic Studies Program.

Urquhart D., author. 1973. The Effects of Oil Exploration Activities on Caribou, Muskoxen, and Arctic Foxes on Banks Island, N.W.T. in: Oil Exploration and the Banksislanders. N.M. Simmons and T.W. Barry, editors. Canadian Wildlife Service. 147 pp.

US Fish and Wildlife Service. 1995. Habitat Conservation Strategy for Polar Bears in Alaska. Anchorage AK: U.S. Fish and Wildlife Service. 119pp.

USDOC, Bureau of the Census. 1971. 1970 Census of Population and Housing, Alaska: Final Population and Housing Unit Counts. Washington, DC: U.S. Government Printing Office.

USDOC, Bureau of the Census. 1991. 1990 Census of Population, Vol. 1. Pacific Division. 1990 Census of Population and Housing, Summary Tape File 1A. Issued September 1991. CD90-1A-9-1. Washington, DC: USDOC, Bureau of the Census, Data User Svs.

USDOC, N. 1997. United States Government Flight Information Supplement for Alaska. Washington DC: USDOC, NOAA.

USDOD, D.O.T.N. 1978. Final EIS for Continuing Exploration and Evaluation of NPR-A, Alaska (Zone A). Washington, DC: USDOD, Dept. of the Navy, Office of Naval Petroleum and Oil Shale Reserves.

USDOD, U.A.C. and E. Environmental Research and Technology. 1984. Endicott Development Project, Final Environmental Impact Statement. Anchorage, Alaska: USDOD, US Army COE, Alaska District.

USDOI. 1986. Arctic National Wildlife Refuge, Alaska Costal Plain Resource Assessment. Draft report and recommendation of the Congress of the United States and legislative EIS. Washington, DC: U.S. Dept. of the Interior. 172 pp.

USDOI, B. 1983c. 810 Analysis. Anchorage, AK: USDOI, BLM.

USDOI, B. 1982c. Barrow Subsistence Hearing. Anchorage, AK: USDOI, BLM.

USDOI, B. 1978a. Fish and Wildlife Resources. *In*: National Petroleum Reserve in Alaska - Values and Resource Analysis. Study Report 2. 105 (c) Land Use Study Vol. 3/Section 6. Anchorage, AK: USDOI, BLM. 224 pp.

USDOI, B. 1978b. National Petroleum Reserve in Alaska - Ecological Profile. Study Report 4. 105 (c) Land Use Study. Anchorage, AK: USDOI, BLM. 118 pp.

USDOI, BLM. 1979. 105 (c) Final Study Vol. 2. Summaries of Studies. April 1979.

USDOI, B. 1991. The NPR-A: A Reader. Anchorage, AK: USDOI, BLM.

USDOI, B. 1981. NPR-A: Final Environmental Assessment Federal Oil and Gas Lease Sale. Anchorage, AK: USDOI, BLM.

USDOI, B. 1983a. Oil and Gas Leasing in the National Petroleum Reserve in Alaska, Final EIS. Anchorage, AK: USDOI, BLM.

USDOI, B. 1983b. A Record of Decision. Anchorage, AK: USDOI, BLM.

USDOI, B. 1982a. Scoping Document for Future Oil and Gas Leasing in NPR-A. Anchorage, AK: USDOI, BLM.

USDOI, B. 1982b. The Scoping Process As a Decision Framework: The NPR-A Experience. Anchorage, AK: USDOI, BLM.

USDOI, BLM. 1990. Western Arctic Resource Management Plan: Management Situation Analysis. Fairbanks and Anchorage, AK: USDOI, BLM. February 5, 1990.

USDOI, BLM. 1997. Public Scoping for the NPR-A Integrated Activity Plan/Environmental Impact Statement, Barrow, Alaska, Monday, March 17, 1997. Bureau of Land Management. Fairbanks, AK: USDOI, BLM. 25 pp.

USDOI, MMS, Alaska OCS Region. 1997. Beaufort Sea Planning Area Oil and Gas Lease sale 170 Draft Environmental Impact Statement. OCS EIS/EA MMS 97-0011. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, B. 1997. Scoping Report for the NPR-A IAP/EIS. Anchorage, AK: USDOI, BLM.

BLANK PAGE

USDOI, B. 1990. Western Arctic Resource Management Plan, Subsistence Management Situation Analysis. Anchorage, AK: USDOI, BLM.

USDOI, B. 1979e. Wild and Scenic Rivers Report. Fairbanks, AK: USDOI, BLM, Northern District Files.

USDOI, B.N.-A.T.F. 1979d. NPR-A 105(c) Final Study, Vol. 3, Record of Public Participation. Anchorage, AK: USDOI, BLM, NPR-A Task Force.

USDOI, B.N.-A.T.F. 1979c. NPR-A 105(c) Final Study, Vol. 1, Summaries of Values and Resource Analysis and Land Use Operations. Anchorage, AK: USDOI, BLM, NPR-A Task Force.

USDOI, B.N.-A.T.F. 1978b. NPR-A 105(c) Land Use Study, Ecological Profile, Study Report 4. Anchorage, AK: USDOI, BLM, NPR-A Task Force.

USDOI, B.N.-A.T.F. 1979a. NPR-A 105(c) Land Use Study, Planning Area Analysis, Study Report 6. Anchorage, AK: USDOI, BLM, NPR-A Task Force.

USDOI, B.N.-A.T.F. 1978d. NPR-A 105(c) Land Use Study, Recreation Resources Wildlife Viewing Areas, Vol. 2, Sec. 3. Anchorage, AK: USDOI, BLM, NPR-A Task Force.

USDOI, B.N.-A.T.F. 1978c. NPR-A 105(c) Land Use Study. Values and Resources Analysis, Study Report 2, Vol. 1. Anchorage, AK: USDOI, BLM, NPR-A Task Force.

USDOI, B.N.-A.T.F. 1978e. NPR-A 105(c) Values and Resource Analysis, Vol. 3, Section 6, Fish and Wildlife Resources. Anchorage, AK: USDOI, BLM, NPR-A Task Force.

USDOI, B.N.-A.T.F. 1978. NPR-A 105(c) Values and Resource Analysis, Vol. 3, Section 9, Watershed Resources. Anchorage, AK: USDOI, BLM, NPR-A Task Force, 22 pp. (multiple pagination).

USDOI, B.N.-A.T.F. 1978a. NPR-A. Final Report Summaries, Study Reports 1-6. Anchorage, AK: USDOI, BLM, NPR-A Task Force.

USDOI, B.N.-A.T.F. 1978d. NPR-A Task Force Study, Wilderness Resources, Vol. 2, Sec. 4. Anchorage, AK: USDOI, BLM, NPR-A Task Force.

USDOI, BLM, NPR-A Task Force. 1979. Values and Resources Analysis. NPR-A 105(c) Study Report No. 2. Anchorage, AK: USDOI, BLM.

USDOI, BLM and MMS. 1997. NPR-A Symposium Proceedings: Science, Traditional Knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve-Alaska. Apr. 16-18, 1977, Anchorage, AK. OCS Study, MMS 97-0013. Anchorage, AK: USDOI, BLM and MMS.

USDOI Fish and Wildlife Service, compiler. 1983. Oil and Gas Leasing in the National Petroleum Reserve in Alaska, Final Environmental Impact Statement. Anchorage AK: USDOI, BLM.

USDOI, Fish and Wildlife Service. 1982. Recovery Plan for the Peregrine Falcon - Alaska Population. Anchorage, AK: USDOI, FWS, Region 7, 69 pp. Prepared in cooperation withe the Peregrine Falcon Recovery Team.

USDOI, FWS. 1996. Spectacled Eider Recovery Plan. Anchorage AK: USFWS, 157 pp.

USDOI, FWS. 1996. Spectacled Eider Recovery Plan. Anchorage AK: USFWS, 157 pp.

USDOI, Fish Wildlife Service. 1995. Draft Habitat Conservation Strategy for Polar Bears in Alaska. Anchorage, AK: USDOI, Fish and Wildlife Service, 91 pp.

USDOI Fish Wildlife Service. 1995. Habitat Conservation Strategy for Polar Bears in Alaska. Anchorage, AK: USDOI, Fish and Wildlife Service, 119pp.

USDOI, FWS, compiler. Arctic National Wildlife Refuge, Alaska Coastal Plain Resource Assessment, Report and Recommendation to the Congress of US and Final Environmental Impact State.

USDOI, F. 1997. Final Environmental Assessment: Development of Proposed Treaty US/Russia Bilateral Agreement for the Conservation of Polar Bears in the Chukchi/Bering Seas. Anchorage, AK: USDOI, FWS, 60 pp.

USDOI, FWS. 1989. The Yukon-Kuskokwim Delta Goose Management Plan. Anchorage, AK: USDOI, FWS, 9 pp. plus figures for some fluctuations since the 1960's.

USDOI, MMS. 1996d. An Assessment of the Undiscovered Hydrocarbon Potential of the Nation's Outer Continental Shelf, A Resource Evaluation Program Report. OCS Report, MMS 96-0034. USDOI, MMS, 40 pp.

USDOI, MMS. 1979b. Public Testimony of Mr. Phillip Tiklook. *In*: Public Hearing, Beaufort Sea Lease Sale. May 15, 1979, Kaktovik, AK. USDOI, MMS, Alaska OCS Region. Anchorage, AK., p. 16.

USDOI, M.A.O.R. 1990. Beaufort Sea Planning Area Oil and Gas Lease Sale 124, Final Environmental Impact Statement. OCS EIS/EA, MMS 90-0063. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, M.A.O.R. 1996a. Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final EIS. OCS EIS/EA, MMS 96-0012. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS, Alaska OCS Region. 1997. Beaufort Sea Planning Area Oil and Gas Lease Sale 170 Draft Environmental Impact Statement. 1 Volume. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS, Alaska OCS Region. 1996. Cook Inlet Planning Area Oil and Gas Lease Sale 149 Final Environmental Impact Statement. 2 Vols. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS, Alaska OCS Region. 1996b. Cook Inlet Planning Area Oil and Gas Lease Sale 149 Final Environmental Impact Statement. 2 Volumes. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS, Alaska OCS Region. 1995. Gulf of Alaska/Yakutat Planning Area Oil and Gas Lease Sale 158 Draft Environmental Impact Statement. 1 Volume. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS, Alaska OCS Region. 1995. Gulf of Alaska/Yakutat Planning Area Oil and Gas Lease Sale 158 Draft Environmental Impact Statement. 1 Volume. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS, Alaska OCS Region. 1997. NPR-A Symposium Hearings, April 16-18, 1997, Anchorage Alaska. Prepared for USDOI, MMS, by MBC Applied Environmental Services. OCS Study MMS 97-0013, Contract No. 14-35-01-96-RC-3801. Anchorage, AK: USDOI, MMS, Alaska OCS Region, June 1997.

USDOI, MMS. 1997. Public Hearing on the Beaufort Sea Sale 170 Draft EIS, Nuiqsut, Alaska, June 24, 1997. Minerals Management Service. Anchorage, AK: USDOI, Minerals Management Service, 62 pp.

USDOI, M.A.O.R. 1995g. Public Hearing on the Beaufort Sea Sale 144 DEIS. Oct. 26, 1995, Anchorage, AK. Anchorage, AK: USDOI, MMS, Alaska OCS Region. 23 pp.

USDOI, M.A.O.R. 1995i. Public Hearing on the Beaufort Sea Sale 144 DEIS. Nov. 7, 1995, Kaktovik, AK. Anchorage, AK: USDOI, MMS, Alaska OCS Region. 24 pp.

USDOI, M.A.O.R. 1995j. Public Hearing on the Beaufort Sea Sale 144 DEIS. Nov. 6, 1995, Nuiqsut, AK. Anchorage, AK: USDOI, MMS, Alaska OCS Region. 36 pp.

USDOI, U.S. Geological Survey. 1979. An Environmental Evaluation of Potential Petroleum Development on the National Petroleum Reserve in Alaska. USDOI, U.S. Geological Survey. Prepared under Section 105(b) of the Naval Petroleum Reserves Production Act of 1976.

USDOI, U.S.G.S. 1985. The National Petroleum Reserve in Alaska, Earth Science Considerations. USDOI, USGS.

Valkenburg P. J.L. Davis, author. 1986. Population Status of the Fortymile Caribou Herd and Identification of Limiting Factors. Progress Report Federal Aid Wildlife Restoration Project W22-4, W22-5 Job 3.32R. Juneau AK: ADF&G.

Valkenburg P., J.R. Dau, T.o. Osborne, G. Carroll, and R.R. Nelson. 1993. Investigations and Improvement of Techniques for Monitoring Recruitment, Population Trend, and Nutritional Status in the Western Arctic Caribou Herd. Project W-24-1, Study 3.40. Federal Aid in Wildlife Restoration. Juneau, AK: Alaska Department of Fish and Game, 12pp.

Valkenburg, P. and J.L. Davis. 1985. The Reaction of Caribou to Aircraft: A Comparison of Two Herds. AlnA: Caribou and Human Activity Proceedings of the First North American Workshop, A.M. Martell and D.E. Russell, eds. September 28-29, 1983, Whitehorse, Y.T., Canada. Ottawa, Ontario, Canada: Canadian Wildlife Service, pp. 7-9.

Van Zyll de Jong C.G. 1975. The Distribution and Abundance of the Wolverine (Gulo) in Canada. *Canadian Field Naturalist* 89(4): 431-437.

Varoujean, D.H. and W.A. Williams. 1987. Nest Locations and Nesting Habitat of the Marbled Murrelet in Coastal Oregon. Final Report. Portland, OR: State of Oregon, Dept. of Fish and Wildlife, 51 pp.

Volt, G. 1997. Telephone Conversation in April, 1997 From Caryn Smith, USDOI, MMS Alaska OCS Region, to Gail Volt, State of Alaska, Department of Environmental Conservation, Spill Prevention and Response, Anchorage Office. Subject: ADEC Oil Spill Database Quality Assurance/Quality Control.

Wahrhaftig, C. 1965. Physiographic Divisions of Alaska. USGS Professional Paper No. 482. Anchorage, AK: U.S. Geological Survey, 52 pp.

Walker, D.A. and M.D. Walker. 1991. History and Pattern of Disturbance in Alaskan Arctic Terrestrial Ecosystems: A Hierarchical Approach to Alalysing Landscape Change. Journal of Applied Ecology 24: 244-276.

Walker, D.A. 1996. Disturbance and Recovery of Arctic Alaskan Vegetation. Landscape Function and Disturbance in Arctic Tundra, J.F. Reynolds and J.D. Tenhunen, eds. Berlin, Germany: Springer-Verlag, pp. pp. 35-71 437 pp. have

Walker, D.A., D. Cate, J. Brown, and C. Racine. 1987. Disturbance and Recovery of Arctic Alaskan Tundra Terrain: A Review of Investigations. CRREL Report 87-11, July 1987.

Walker, D.A., P.J. Webber, E.F. Binnian, K.R. Everett, N.D. Lederer, E.A. Nordstrand, and M.D. Walker. 1987. Cumulative Impacts of Oil Fields on Northern Alaskan Landscapes. Science 238, 6 November 1987: 237-239.

Walker, D.A. and W. Acevedo. 1987. Vegetation and Landsat-Derived Land Cover Map of the Beechy Point Quadrangle, Arctic Coastal Plain, Alaska. USDOD, US Army COE, CRREL, 63 pp.

Walker, D.A., W. Acevedo, K.R. Everett, L. Gaydos, J. Brown, and P.J. Webber. 1982. LANDSAT-Assisted Environmental Mapping in the Arctic National Wildlife Refuge, Alaska. CRREL Report 82-37. USDOD, US Army COE, CRREL.

Walker, D.A., E.F. Binnian, N.D. Lederer, E.A. Nordstrand, R.H. Meehan, M.D. Walker, and P.J. Webber. 1986a. Cumulative Landscape Impacts In The Prudhoe Bay Oil Field 1949-1983. Final Report. Anchorage, AK: USDOI, USFWS, Habitat Resources Division.

Walker, D.A., E.F. Binnian, N.D. Lederer, E.A. Nordstrand, R.H. Meehan, M.D. Walker, and P.J. Webber. 1986. Cumulative Landscape Impacts in the Prudhoe Bay Oil Field 1949-1983. Anchorage, AK: USDOI, FWS, p. iv, 52 pp. plus 3 appendices.

Walker, D.A., N. Lederer, M.D. Walker, E. Binnian, K.R. Everett, E. Norstrand, and P.J. Webber. 1989. Response (Impacts of Petroleum Development in the Arctic [Technical Comment]). *Science* 245: 765-766. Walker et al. 1987, attached to Robertson 1989.

Walker, D.A., P.J. Webber, M.D. Walker, N.D. Lederer, R.H. Meehan, and E.A. Nordstrand. 1986b. Use of Geobotanical Maps and Automated Mapping Techniques to Examine Cumulative Impacts in the Prudhoe Bay Oilfield, Alaska. Environmental Conservation 13 (2): 149-160.

Walker, D.A., P.J. Webber, E. Binnian, K.R. Everett, N.D. Lederer, E. Norstrand, and M.D. Walker. 1987. Cumulative Impacts of Oil Fields on Northern Alaskan Landscapes. *Science* 238(4828): 757-761.

Walker, H.J. 1994. Environmental Impact of River Dredging in Arctic Alaska (1981-89). *Arctic* 47(2): 176-183.

Ward, D.H. and R.A. Stehn. 1989. Response of Brant and Other Geese to Aircraft Disturbance at Izembek Lagoon, Alaska. OCS Study, MMS 89-0046. Anchorage, AK: USDOI, FWS, and USDOI, MMS, 193 pp.

Warnock, N.D. and D.M. Troy. 1992. Distribution and Abundance of Spectacled Eiders at Prudhoe Bay, Alaska: 1991. Northern Alaska Research Studies. Anchorage, AK: BP Exploration (Alaska) Inc., Environmental and Regulatory Affairs Dept., 21 pp.

Weber, D.D., D.H. Maynard, W.D. Gronlund, and V. Konchin. 1981. Avoidance Reactions of Migrating Adult Salmon to Petroleum Hydrocarbons. *Canadian Journal of Fisheries and Aquatic Sciences* 38: 779-781.

Weller, M.W. and D.V. Derksen. 1979. The Geomorphology of Teshekpuk Lake in Relation to Coastline Configuration of Alaska's Coastal Plain. *Arctic* 32: 2.

Whipple, A. 1979. *The Whalers.* Alexandria, VA: Time-Life Books.

Whitten K. 1995. Letter Written in 1995 From K. Whitten, State of Alaska, Dept. of Fish and Game; Subject: Population Status of the Central Arctic Caribou Herd.

Whitten, K.R. 1992. Movement Patterns of the Porcupine Caribou Herd in Relation to Oil Development. Project W-23-5, Study 3.34. Federal Aid in Wildlife Restoration Research Progress Report. Juneau, AK: Alaska Department of Fish and Game, 5pp.

Whitten, K.R. and R.D. Cameron. 1980. Nutrient Dynamics of Caribou Forage on Alaska's Arctic Slope. *In*: Proceedings of the Second International Reindeer/Caribou Symposium, E. Reimers, E. Gaare, and G. Skjenšberg, eds. 1980, Roros, Norway pp. 159-66.

Williams, J.R. 1970. Ground Water in the Permafrost Regions of Alaska. USGS Professional Paper 696. U.S. Geological Survey, 83 pp.

Windisch-Cole, B. 1996. Conversation Dated Aug. 1, 1996, Between Birgitta Windisch-Cole, State of Alaska, Dept. of Labor, ~~and Tim Holder,~~ USDOI, MMS, Alaska OCS Region; Subject: Labor Data and Distribution Between Place of Work and Place of Residence for a Worker.

Winters J.F., R.T. Shideler, authors. 1990. An Annotated Bibliography of Selected References of Muskoxen Relevant to the National Petroleum Reserve - Alaska. Fairbanks AK: ADF&G, 82 pp.

Wolfe, D.A., M.J. Hameedi, J.A. Galt, G. Watabayashi, J.W. Short, C.E. O'Clair, S. Rice, J. Michel, J.R. Payne, J.F. Braddock, S. Hanna, and D.M. Sale. 1993. Fate of the Oil Spilled From the T/V *Exxon Valdez* in Prince William Sound, Alaska. *In*: *Exxon Valdez* Oil Spill Symposium Abstract Book, B. Spies, L.J. Evans, B. Wright, M. Leonard, and C. Holba, eds and comps. Feb. 2-5, 1993, Anchorage, AK. Anchorage, AK: *Exxon Valdez* Oil Spill Trustees, University of Alaska, Sea Grant College Program, and American Fisheries Society, Alaska Chapter, pp. 6-9.

Woods, N. 1979. Testimony at the Public Hearing on the Sale BF Oil and Gas Lease Sale, May 16, 1979, Nuiqsut, Ak. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 37 pp.

Woods, N. 1982. Testimony at the Public Hearing on the Beaufort Sea Sale 71 DEIS, Feb. 3, 1982, Nuiqsut, Ak. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 35 pp.

Woodward, D.F., E. Snyder-Conn, R.G. Riley, and T.R. Garland. 1988. Drilling Fluids and the Arctic Tundra of Alaska: Assessing Contamination of Wetlands Habitat and the Toxicity to Aquatic Invertebrates and Fish. *Archives of Environmental Contamination and Toxicology* 17: 683-697.

Worl, R. 1978. Beaufort Sea Region Sociocultural Systems. Technical Report No. 9. Anchorage, AK: USDOI, BLM, Alaska OCS Office, Socioeconomic Studies Program.

Worl, R. 1978. Beaufort Sea Region Sociocultural Systems. Technical Report No. 9. Anchorage, AK: USDOI, BLM, Alaska OCS Office, Socioeconomic Studies Program.

Worl, R. 1979. Sociocultural Assessment of the Impact of the 1978 International Whaling Commission Quota on the Eskimo Communities. Anchorage, AK: University of Alaska, AEIDC.

Worl, R. and C. Smythe. 1986. A Decade of Modernization. OCS Study, MMS 86-0088. No. 125. Technical Report. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Social and Economic Studies.

Worl, R. and C. Smythe. 1986. Barrow: A Decade of Modernization. Technical Report No. 125. OCS Study, MMS 86-0088. NTIS Access No. A19/PB 87-204673*. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Alaska OCS Social and Economic Studies Program.

Worl, R., R. Worl, and T. Lonner. 1980. Beaufort Sea Sociocultural Systems Update Analysis. Technical Report No. 64. Anchorage, AK: USDOI, BLM, Alaska OCS Office, Socioeconomic Studies Program.

Yunker, M.B. and R.W. Macdonald. 1995. Composition and Origins of Polycylic Aromatic Hydrocarbons in the Mackenzie River and on the Beaufort Sea Shelf. *Arctic* 48(2): 118-129.

Zeh, J. E., A.E. Raftery, and A.A. Schaffner. 1996. Revised Estimates of Bowhead Population Size and Rate of Increase. Forty-Sixth Report of the International Whaling Commission 46(SC/47/AS10): 670-696 pp.

Zhang, T. 1993. Climate, Seasonal Snow Cover and Permafrost Temperatures in Alaska, North of the Brooks Range. Ph.D. Dissertation. Fairbanks, Alaska: University of Alaska Fairbanks, Geophysical Institute, 223 pp.

Zhang, T., S.A. Bowling, and K. Stamnes. 1997. Impact of the Atmosphere On Surface Radiative Fluxes and Snowmelt in the Arctic and Subarctic. *Journal of Geophysical Research* 102((D4)): 4287-4302.

Zhang, T., T.E. Osterkamp, and K. and Stamnes. 1996. Some Characteristics of the Climate in Northern Alaska, USA. *Arctic and Alpine Research* 28((4)): 509-518.

Zhang, T., K. Stamnes, and S.A. Bowling. 1996. Impact of Clouds on Surface Radiative Fluxes and Snowmelt in the Arctic. *Journal of Climatology* 9((9)).

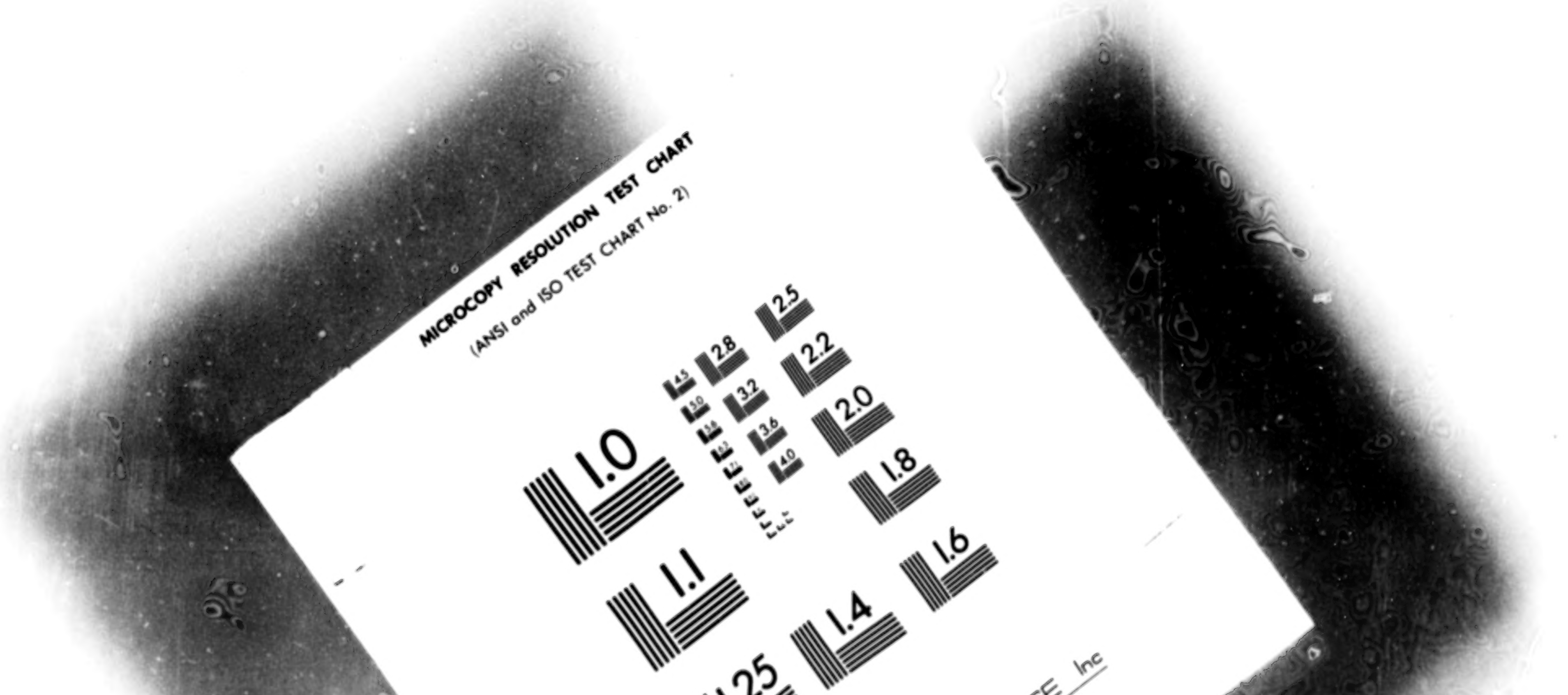
Zwiefelhofer, D.C. and D. Forsell. 1989. Marine Birds and Mammals Wintering in Selected Bays of Kodiak Island, Alaska. Unpublished Report. Kodiak, AK: USDOI, FWS, Kodiak National Wildlife Refuge, 77 pp.

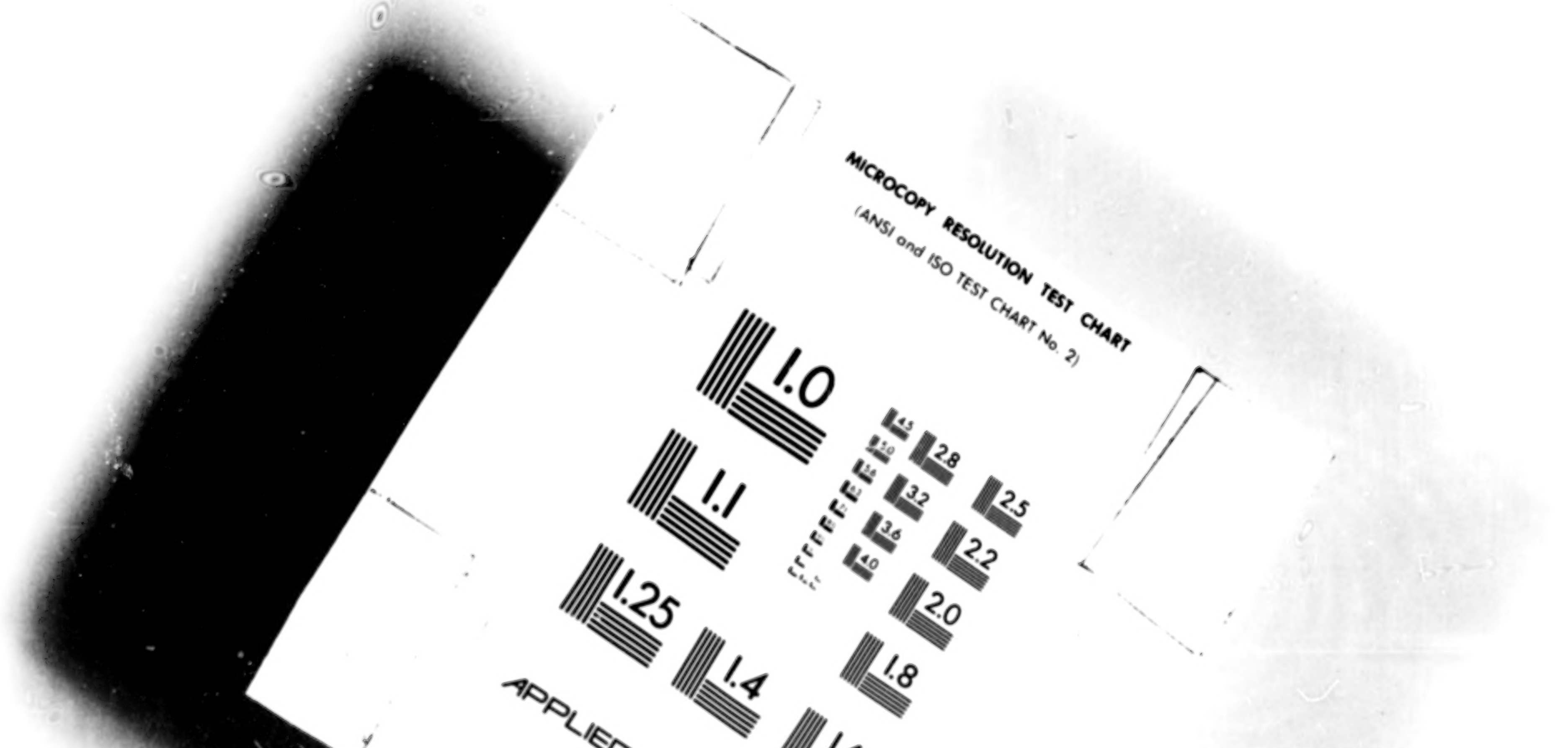
☆ U.S. GOVERNMENT PRINTING OFFICE: 1997 - 689-111 / 41404 REGION No. 10

END

DATE FILMED

07/29/99


MICROCOPY RESOLUTION TEST CHART
(ANSI and ISO TEST CHART No. 2)
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5


MICROCOPY RESOLUTION TEST CHART
(ANSI and ISO TEST CHART No. 2)
1.0
1.1
1.25
1.4
1.8
2.0
2.2
2.5

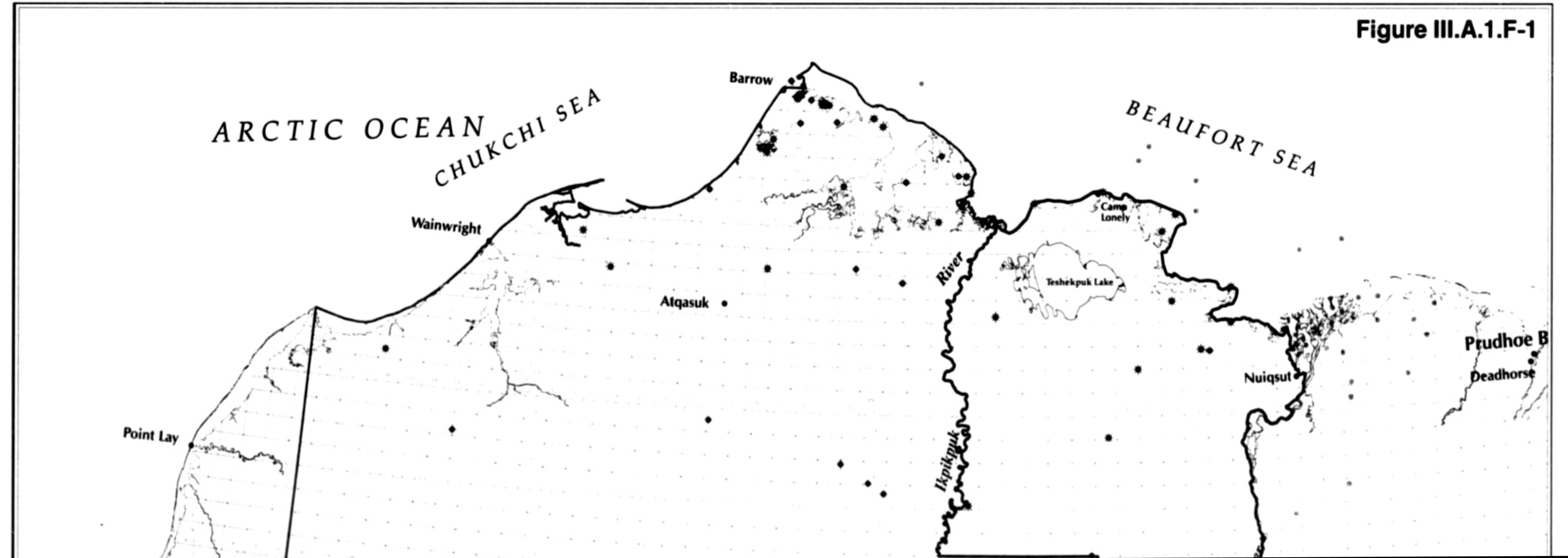
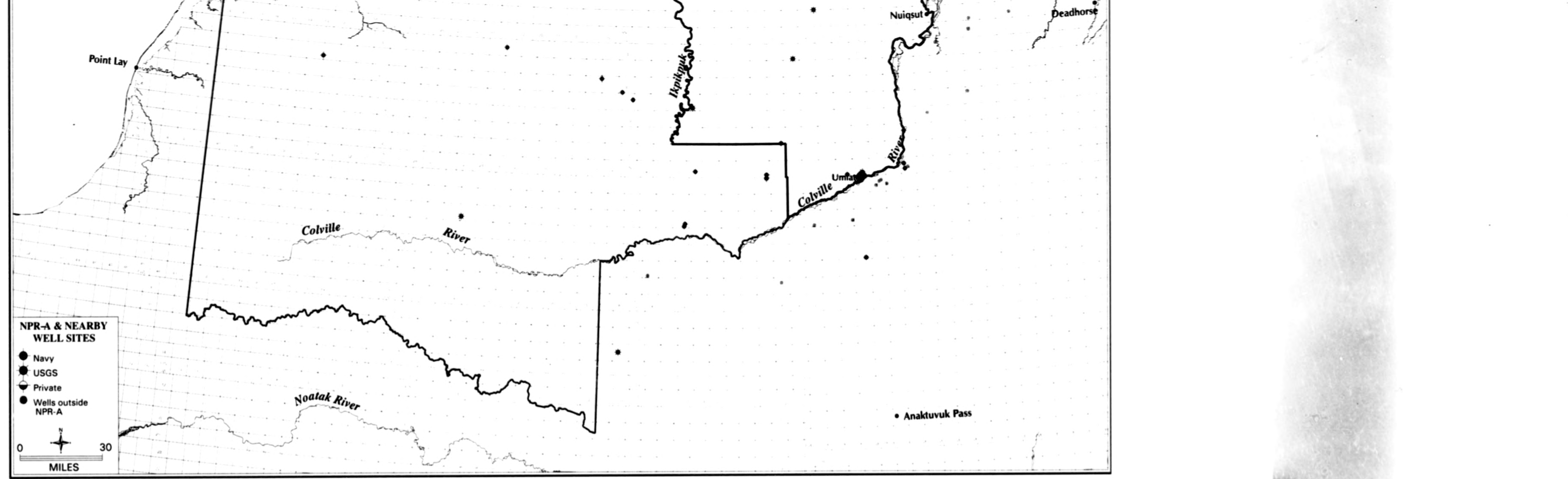
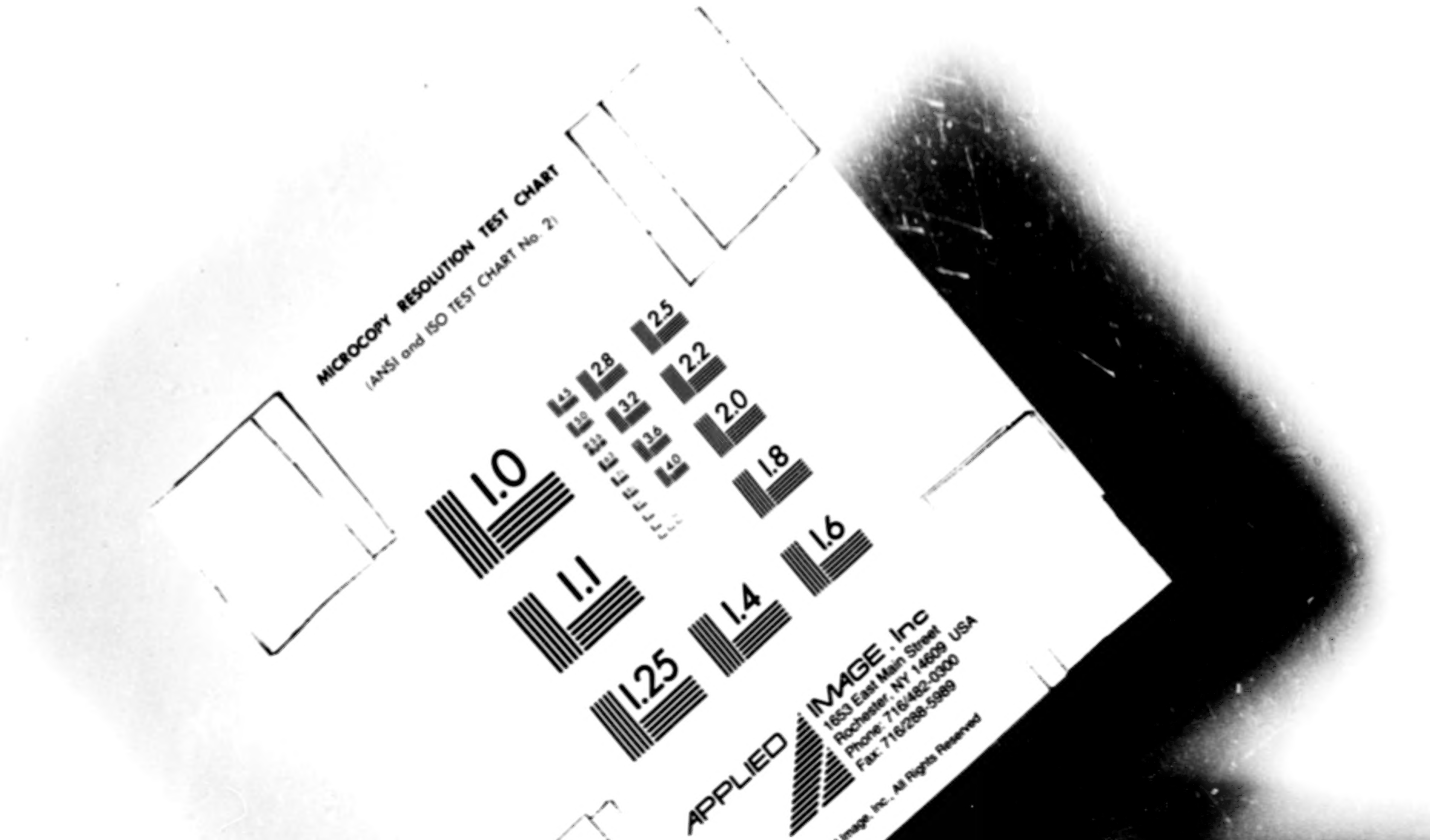


Figure III.A.1.F-1

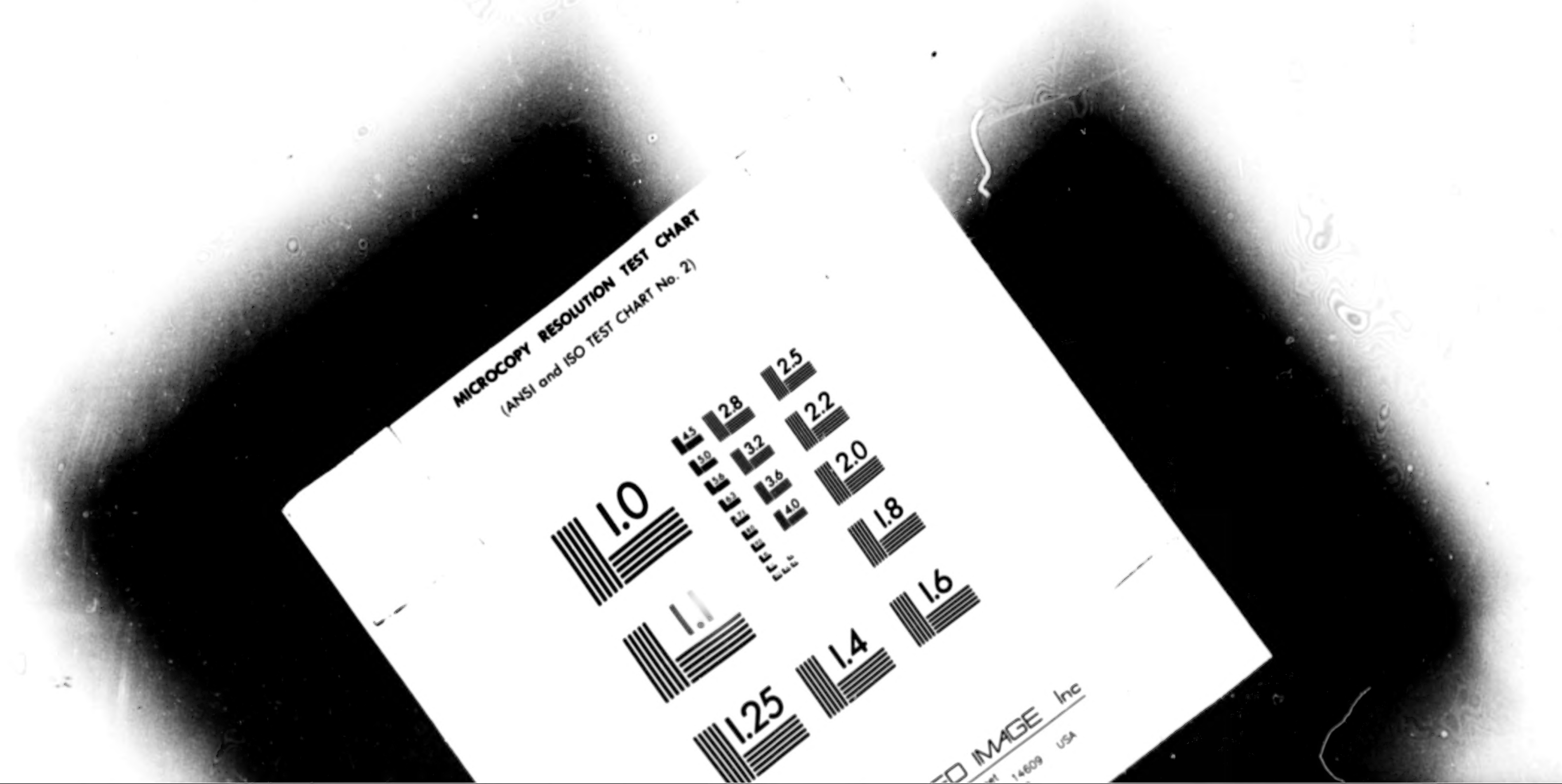


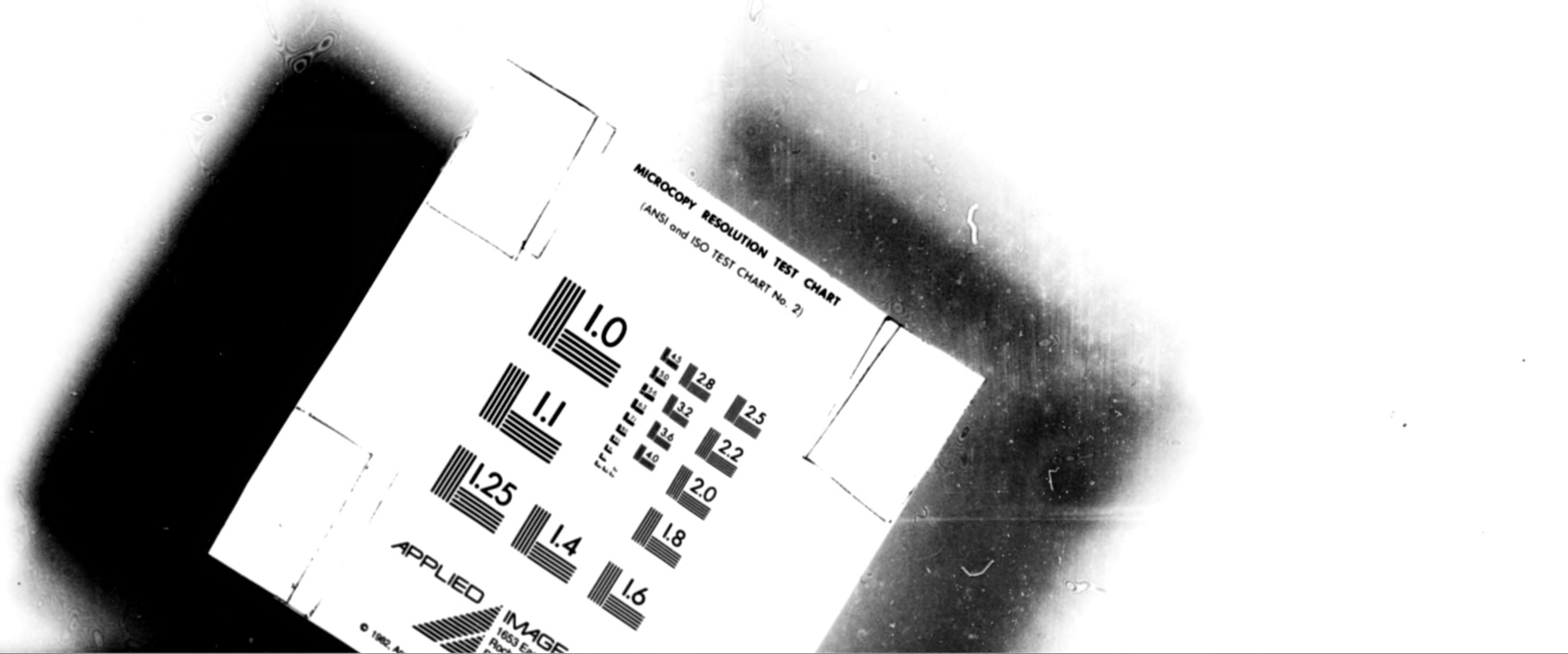
SOURCE: MMS, US Navy records and USGS published report, 1975-1980

BEST COPY AVAILABLE


MICROCOPY RESOLUTION TEST CHART
(ANSI and ISO TEST CHART No. 2)
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
APPLIED IMAGE Inc

MICROCOPY RESOLUTION TEST CHART
(ANSI and ISO TEST CHART No. 2)
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
APPLIED IMAGE Inc


MICROCOPY RESOLUTION TEST CHART
(ANSI and ISO TEST CHART No. 2)
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
APPLIED IMAGE Inc


MICROCOPY RESOLUTION TEST CHART
(ANSI and ISO TEST CHART No. 2)
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
APPLIED IMAGE

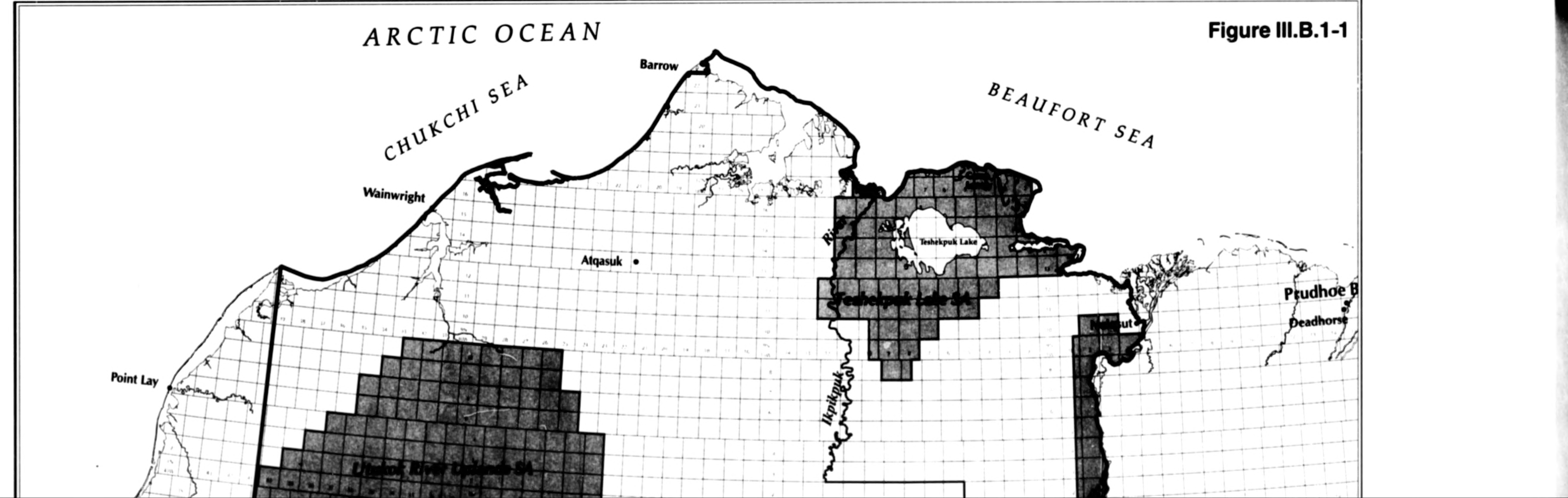
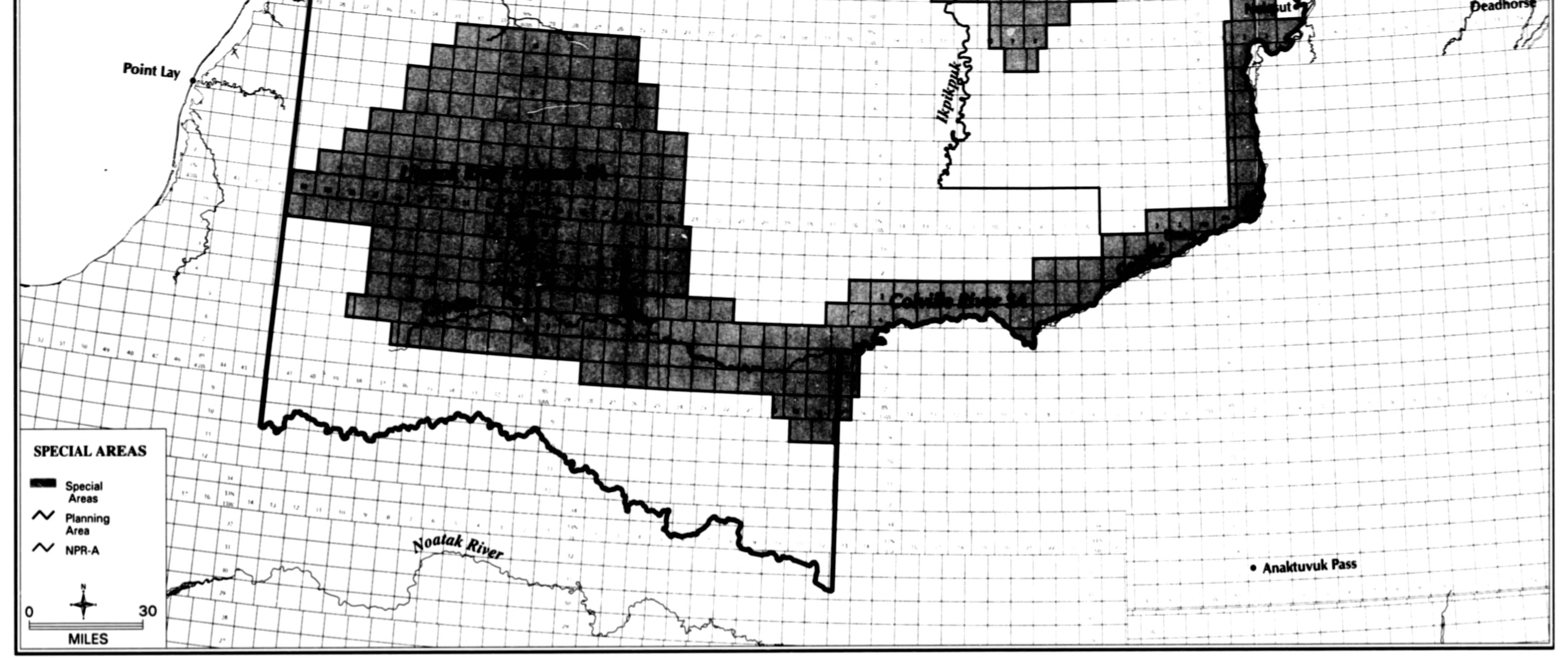
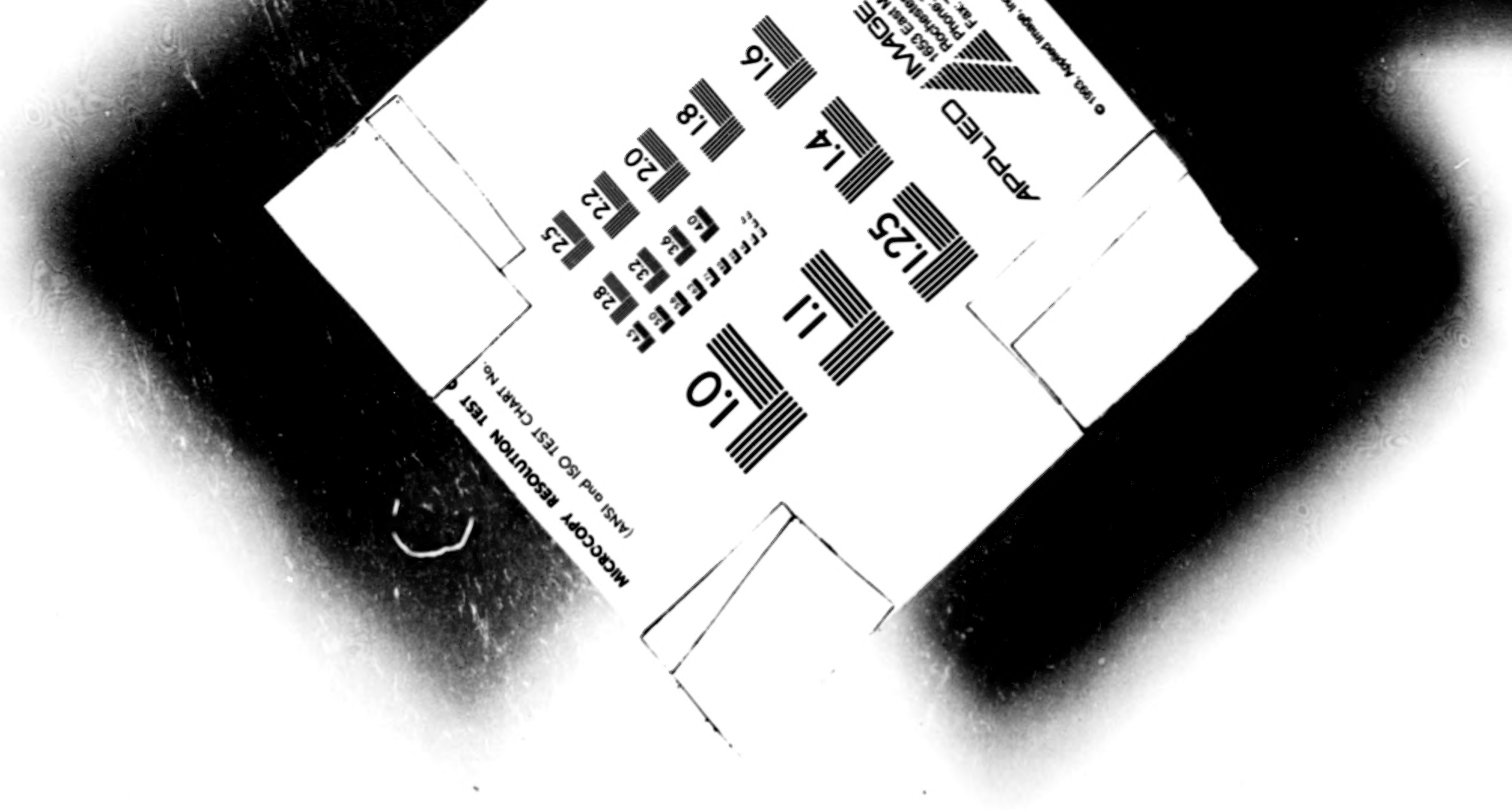


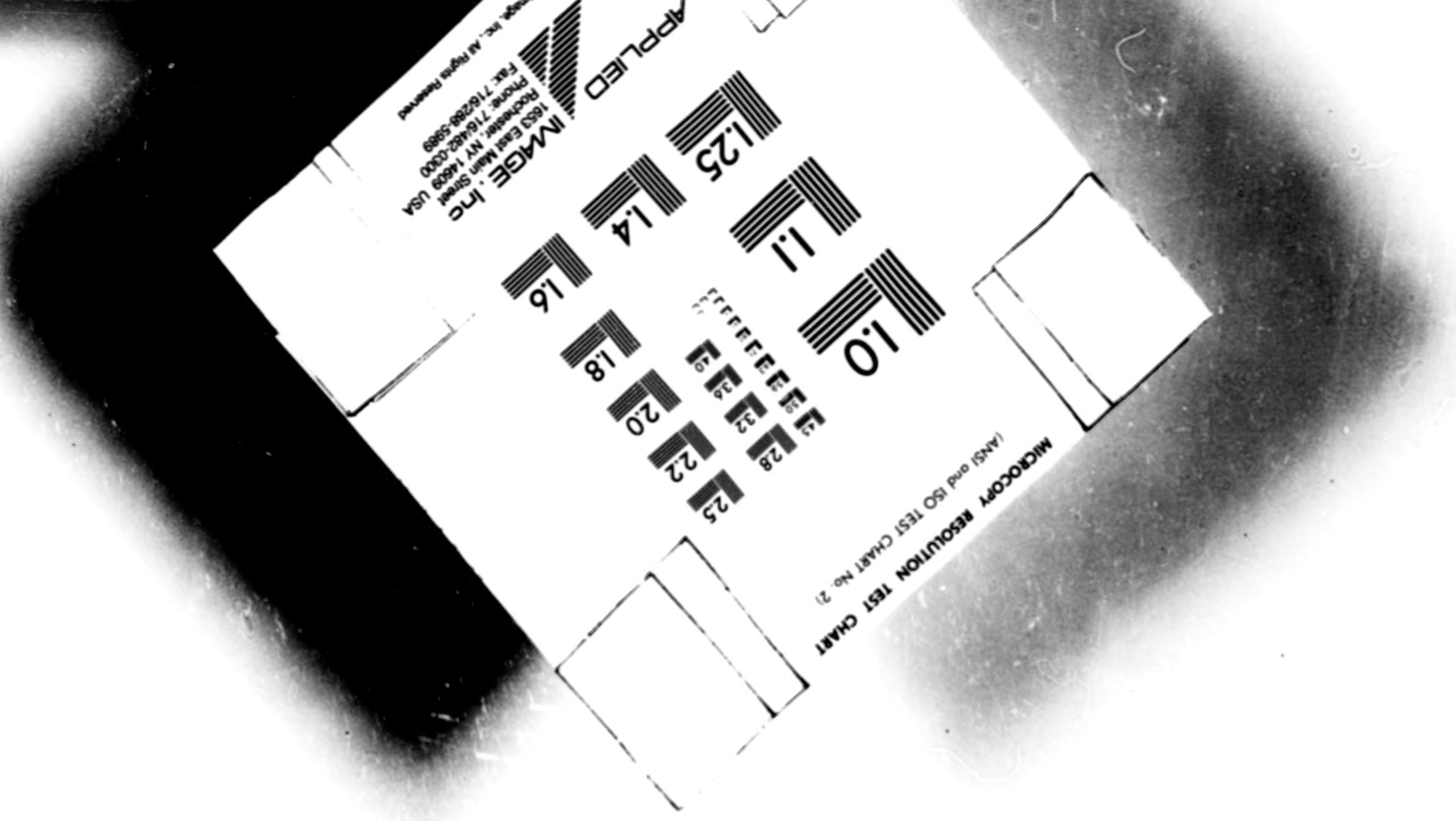
Figure III.B.1-1



BEST COPY AVAILABLE

2


1.0
1.1
1.25
1.4
1.6
1.8


1.0
1.1
1.25
1.4
1.6
1.8

MICROCOPY RESOLUTION TEST CHART
1.0
1.1
1.4
1.6
1.8
2.0
2.2
2.5

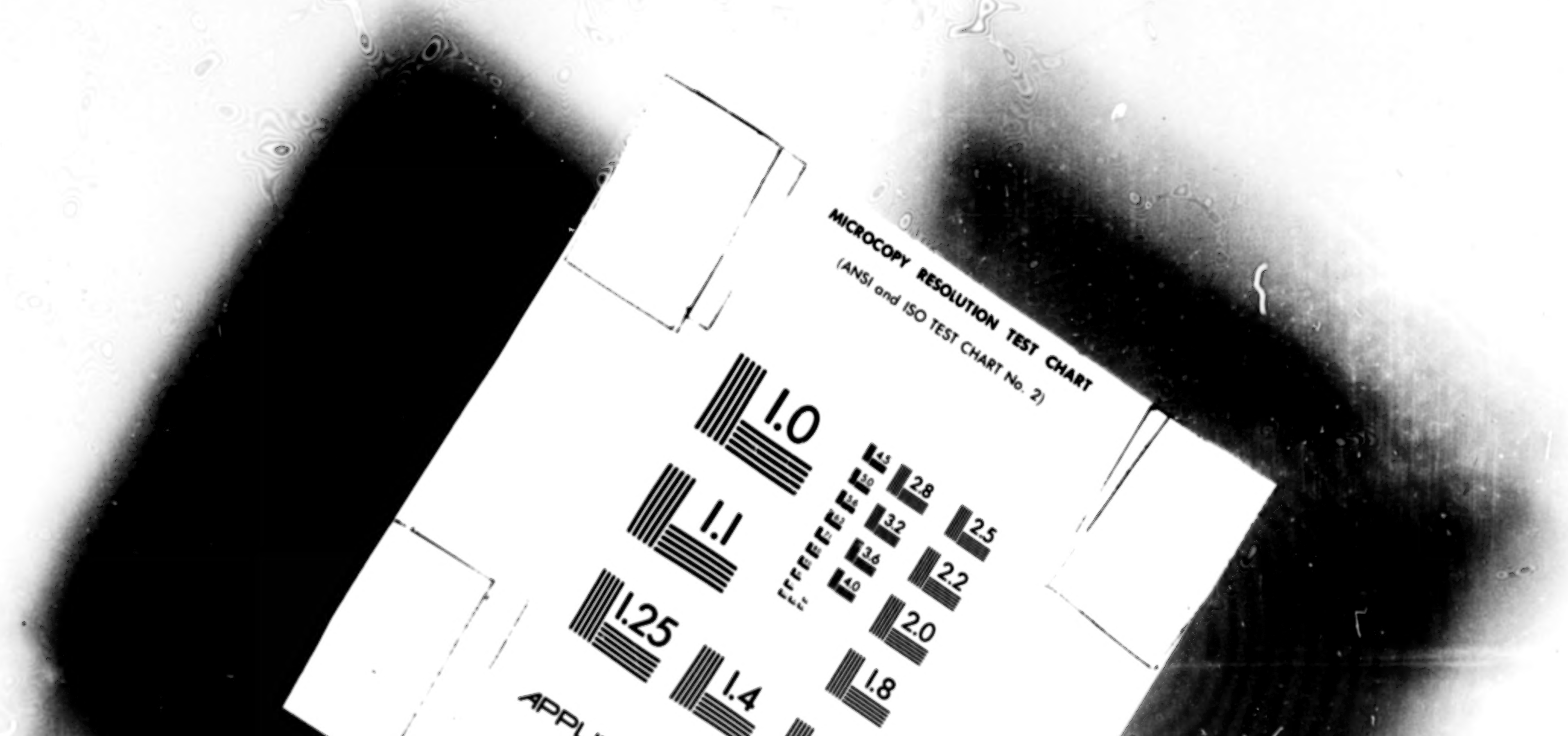
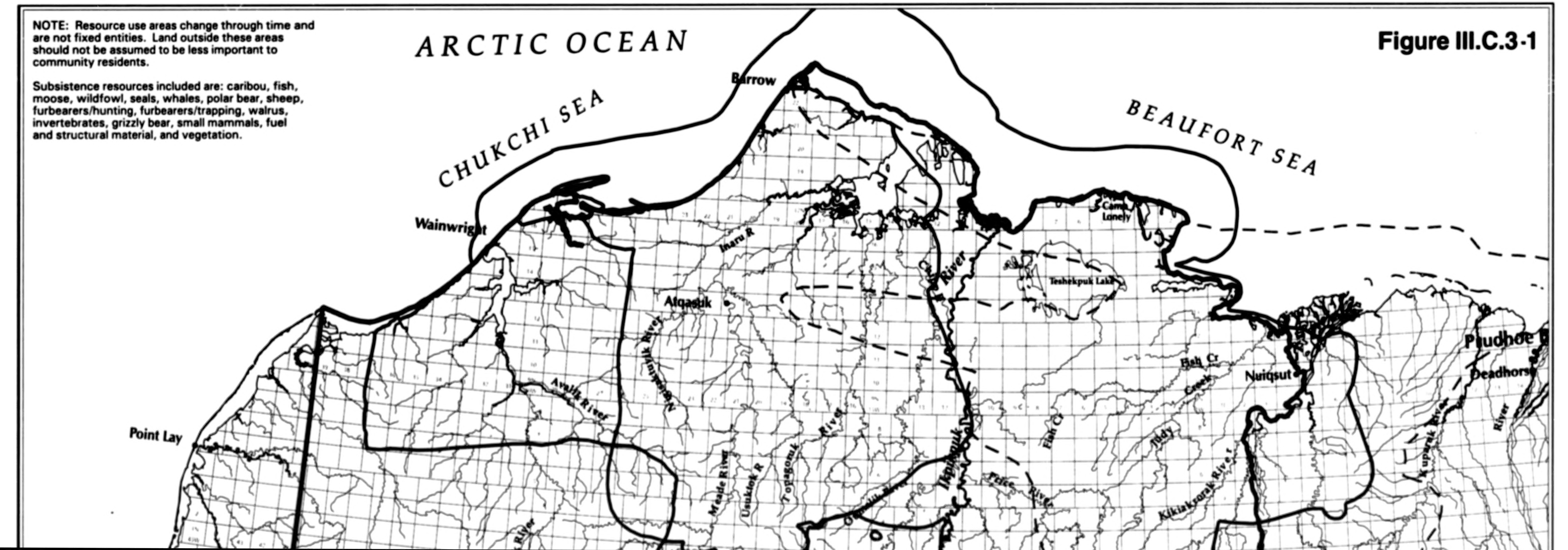
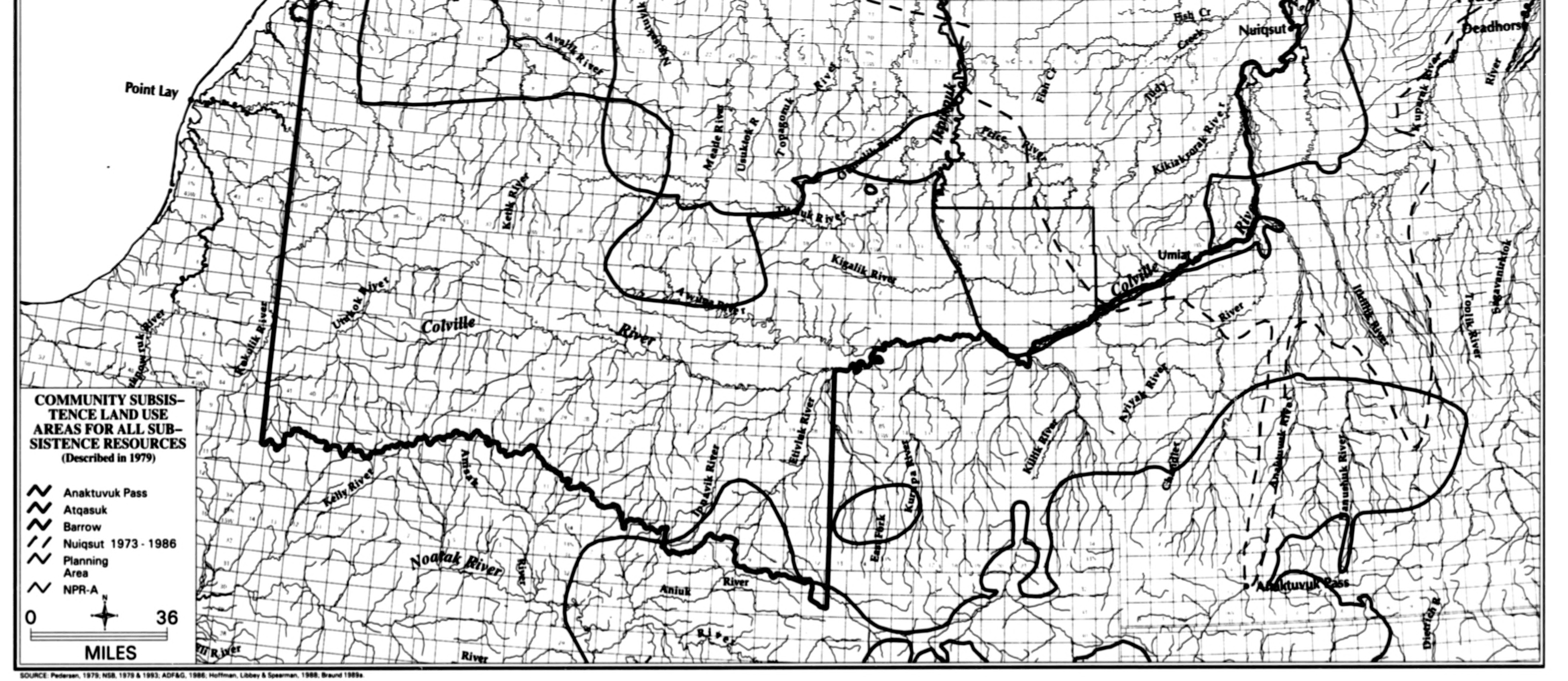

MICROCOPY RESOLUTION TEST CHART
1.0
1.1
1.25
1.4
1.8
2.0
2.2
2.5

Figure III.C.3-1



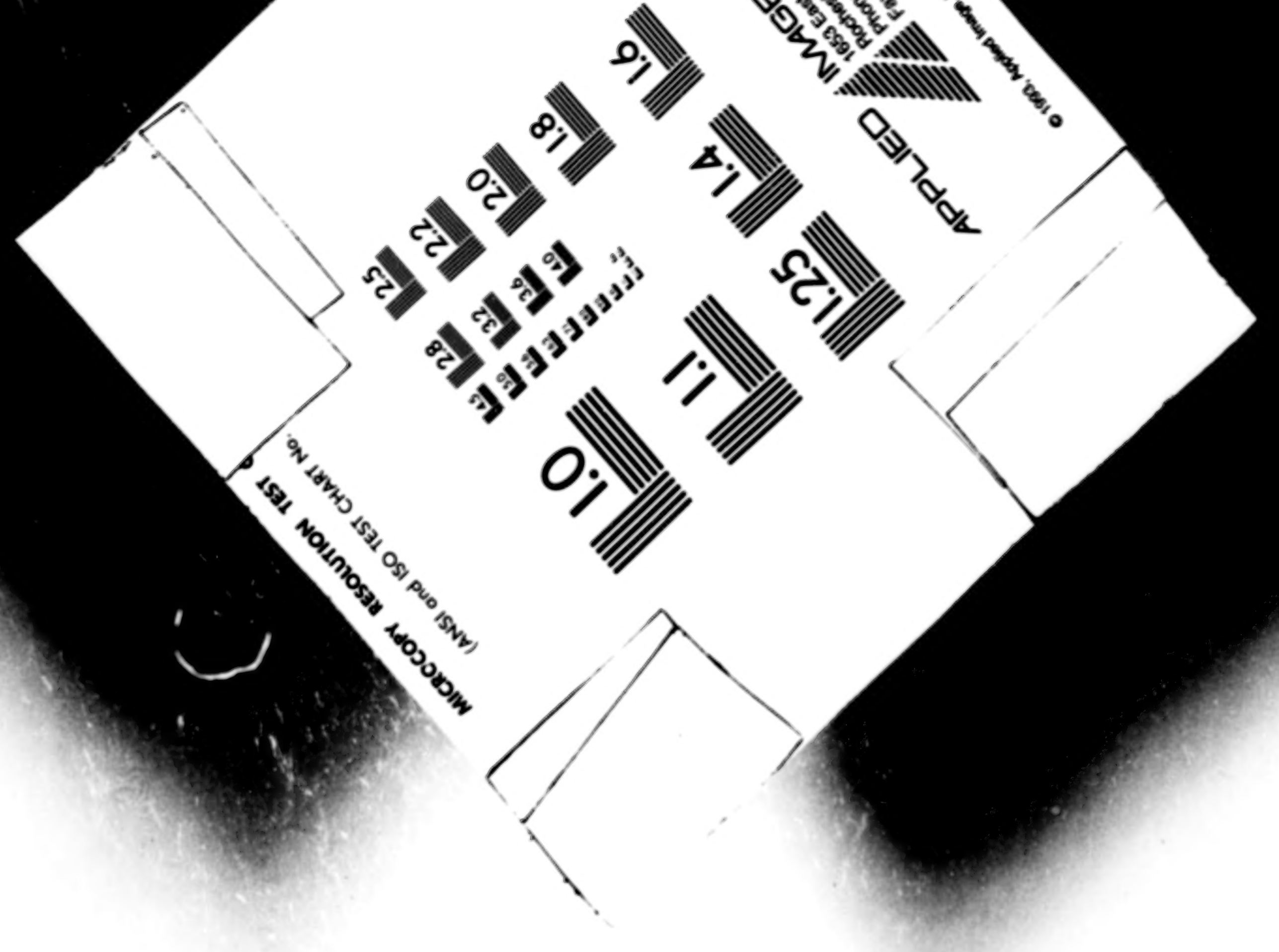
NOTE: Resource use areas change through time and are not fixed entities. Land outside these areas should not be assumed to be less important to community residents.

Subsistence resources included are: caribou, fish, moose, wildfowl, seals, whales, polar bear, sheep, furbearers/hunting, furbearers/trapping, walrus, invertebrates, grizzly bear, small mammals, fuel and structural material, and vegetation.

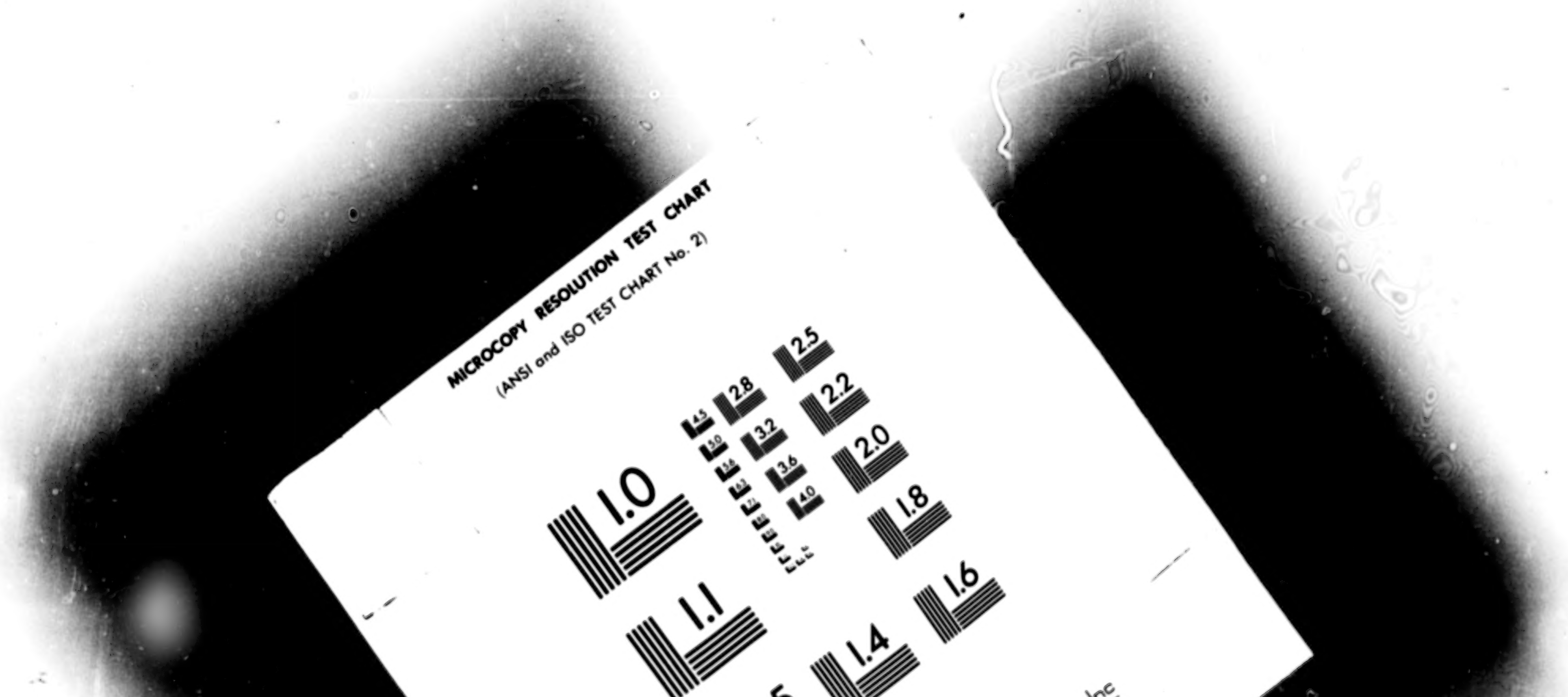


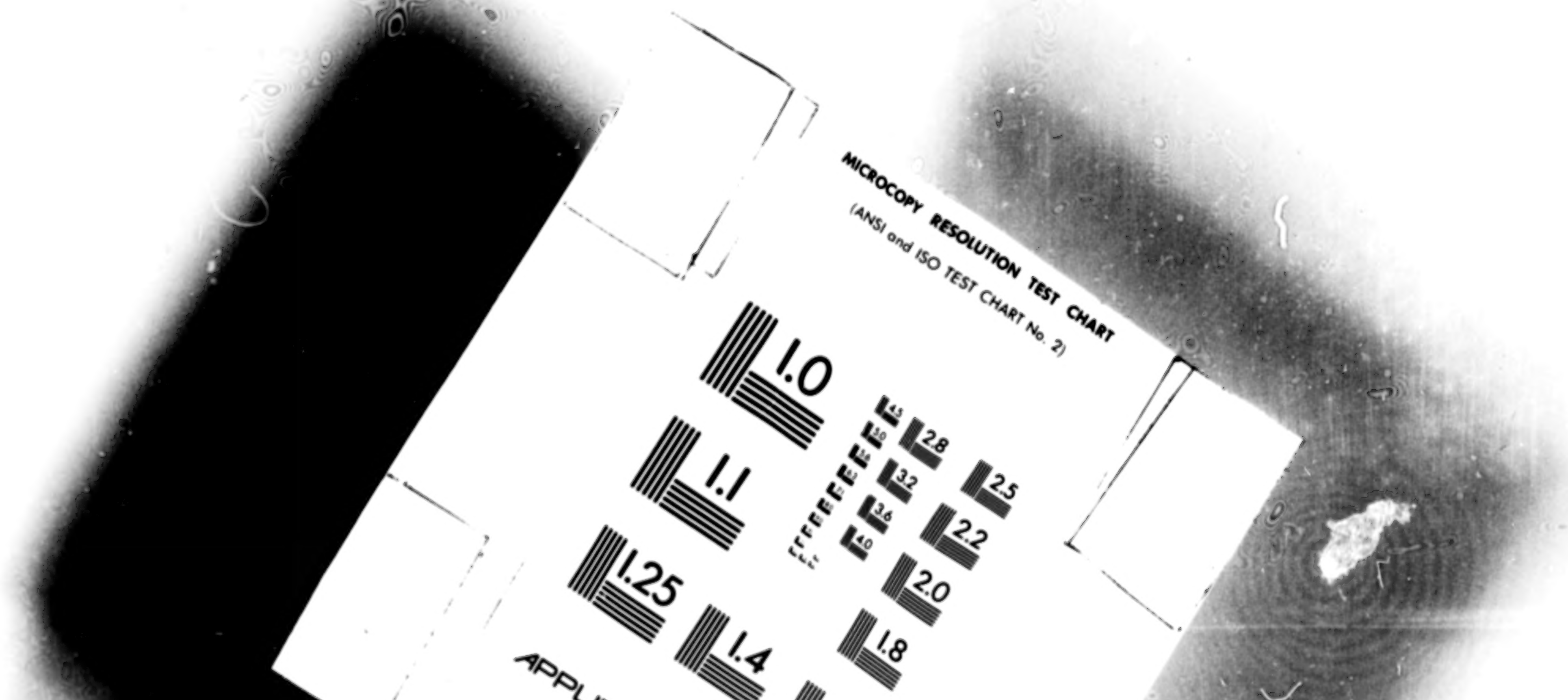
SOURCE: Pedersen, 1979; NSB, 1979 & 1993; ADF&G, 1986; Hoffman, Libbey & Spearman, 1988; Braund 1989a.

BEST COPY AVAILABLE


1.0
1.1
1.25
1.4
1.6

1.0
1.1
1.25
1.4
1.6


MICROCOPY RESOLUTION TEST CHART
(ANSI and ISO TEST CHART No. 2)
1.0
1.1
1.4
1.6
1.8
2.0
2.2
2.5


MICROCOPY RESOLUTION TEST CHART
(ANSI and ISO TEST CHART No. 2)
1.0
1.1
1.25
1.4
1.8
2.0
2.2
2.5

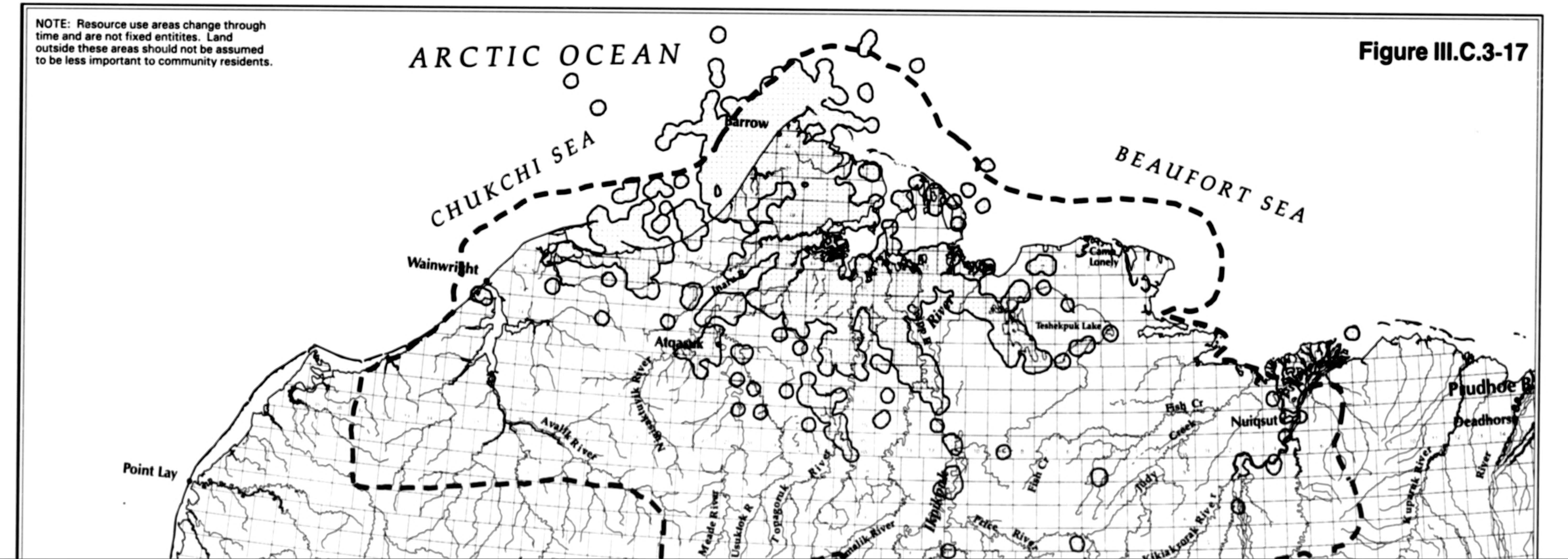
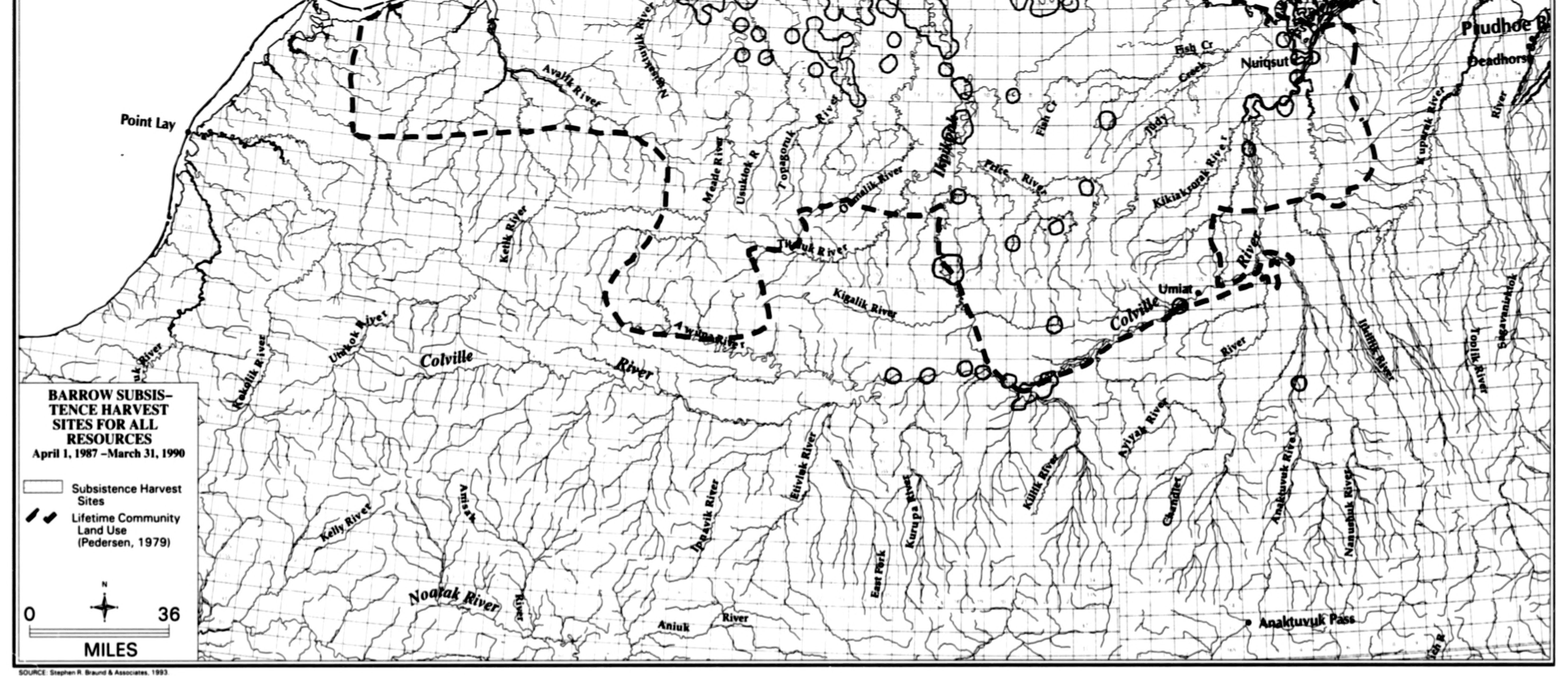


Figure III.C.3-17

NOTE: Resource use areas change through time and are not fixed entitites. Land outside these areas should not be assumed to be less important to community residents.



BARROW SUBSISTENCE HARVEST SITES FOR ALL RESOURCES
April 1, 1987 –March 31, 1990

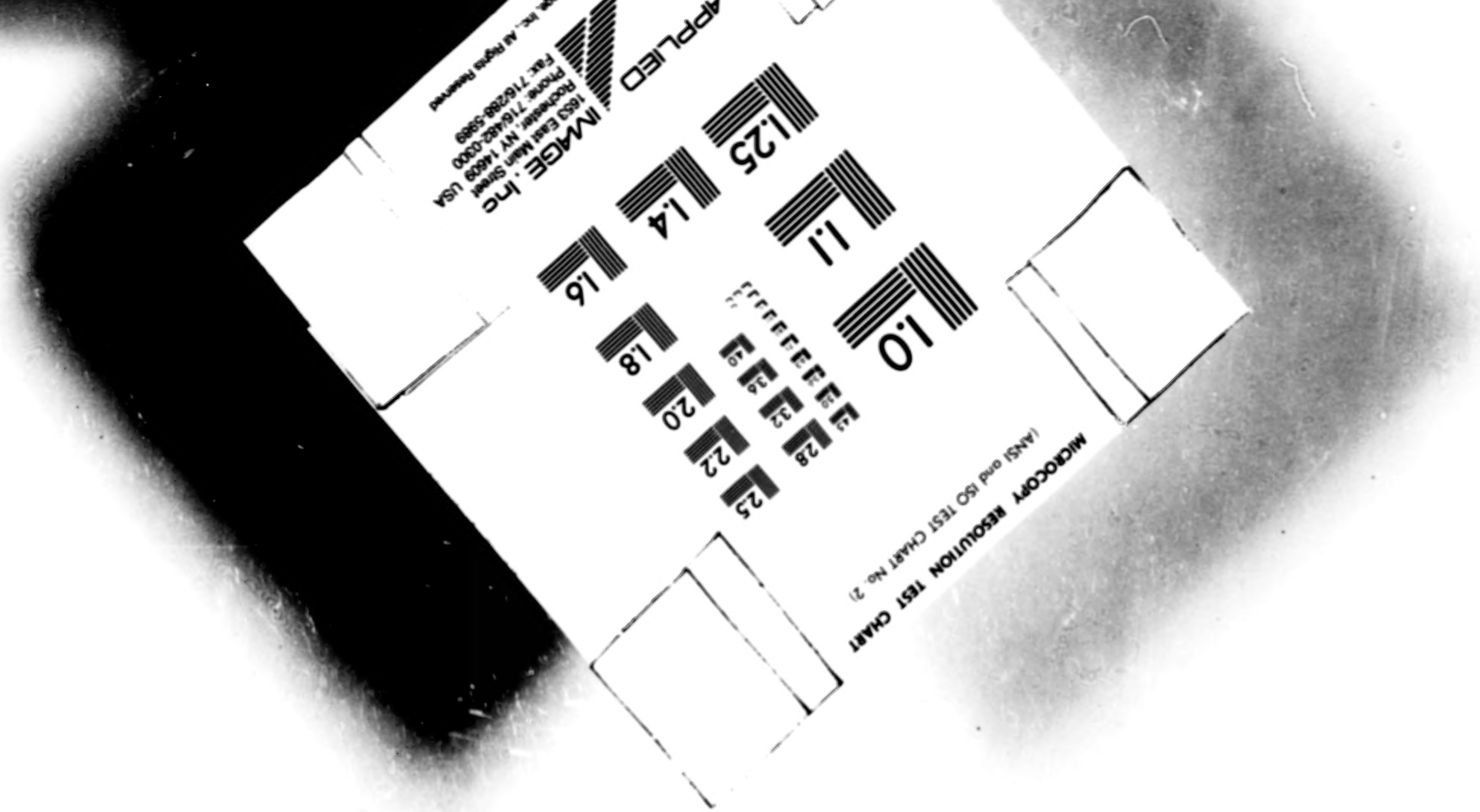
- ▭ Subsistence Harvest Sites
- ▬ ▬ Lifetime Community Land Use (Pedersen, 1979)

SOURCE: Stephen R. Braund & Associates, 1993.

BEST COPY AVAILABLE

4

1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
APPLIED IMAGE
MICROCOPY RESOLUTION TEST CHART


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
APPLIED IMAGE
MICROCOPY RESOLUTION TEST CHART